# Engineering Feasibility Study

# Black Creek

# BLACK CREEK
# ENGINEERING FEASIBILITY STUDY

**HAMILTON, INDIANA**

October 2006

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## 1.0 EXECUTIVE SUMMARY

Evidence of water quality impairment in the Black Creek watershed is documented through photographs of sediment plumes, the presence of sediment deltas at the mouth of Black Creek's discharge into Hamilton Lake, the loss of trees and streambanks to erosion along Black Creek, and the need for lake residents to extend docks near Black Creek to support continued boat access. Given this evidence of water quality impairments DES has focused our efforts on the Black Creek watershed.

The goals and objectives of this study include the following:

- Determine the feasibility of construction sites for proposed structures and/or other pollution control activities such as Best Management Practices (BMPs).
- Complete necessary engineering activities and computations to complete the determination of engineering feasibility.
- Recommend structures and/or activities for implementation.

This study presents watershed specific observations and identified sediment loads to Black Creek and ultimately Hamilton Lake. This study has identified enhancements, which will reduce new sediment loads to the lake. However, none of these enhancements will address the sediment that has built up over the years at the discharge of Black Creek into Hamilton Lake. Given access constraints of the sites, project implementation costs will be higher than normal to implement these water quality enhancement projects.

DES's recommendations are as follows:

1. Address the sediment discharging into Hamilton Lake by constructing streambank stabilization in the areas noted in this study.
2. Begin preparation of a Sediment Management Plan and grant preparation activities in preparation for limited spot dredging at the discharge of Black Creek into Hamilton Lake.
3. Work with the Steuben County Soil and Water Conservation District (SWCD) office to assist them in implementing watershed level practices such as buffer strips and grade control structures in the upper reaches of the watershed, with priority placed on recommended buffer strip locations identified in this study.

The estimated cost to implement all recommendations contained herein is approximately $250,000.

## 2.0 ACKNOWLEDGEMENTS

Dynamic Environmental Services, Inc. (DES) would like to thank the following organizations for assistance in this study effort: Hamilton Lake Association (HLA), Indiana Department of Natural Resources (IDNR) Lake and River Enhancement (LARE), the Steuben Country SWCD, numerous local Steuben County government agencies, and the landowners in the Black Creek watershed and Hamilton, Indiana. Assistance included many forms including providing data, recommendations, and field support. Without this assistance, this study would not be possible.

## 3.0 INTRODUCTION

### 3.1 Background

DES was retained by HLA in January 2006 to perform a lake enhancement engineering feasibility study (EFS) for Black Creek. Black Creek is the most significant non-point pollution source in the Hamilton Lake watershed. The LARE program provided funding to the HLA to perform this EFS. Previously LARE funded activities at Hamilton Lake included a diagnostic feasibility study in 1989, the design of constructed wetland in 1999, and the construction of a constructed wetland in 2000. Over the last several years, the HLA has had weed surveys and weed spraying performed to control invasive aquatic vegetation, also funded by LARE and local match funding.

### 3.2 Study Scope

The Scope of Work (SOW) for this project was modeled after the LARE Technical Requirements of Engineering Feasibility Studies. The scope was modified to reflect DES' professional insight, discussions, and experience working with the HLA during the LARE grant preparation process.

The SOW specifically included the following nineteen (19) tasks:

1. Identification of Potential Construction Sites
2. Complete Engineering Calculations
3. Facilitate Public Meetings Regarding the Proposed Project
4. Create a Public Information Handout
5. Project Progress Reporting
6. Complete Conceptual Drawings
7. Determine Probable Project Costs and Timelines
8. Determine Easements and Land Availability
9. Determine Unusual Physical and/or Social Costs of the Proposed Project
10. Complete a Flood State Analysis (if required)
11. Determine Functionality and/or Impact of Proposed Projects
12. Conduct a Wetland Functional Assessment or Vegetation Survey
13. Evaluate Biological and Habitat Integrity Downstream of Proposed Sites
14. Determine Funding Sources and Capacity for Local Funding
15. Conduct an Environmental Impact Assessment
16. Document Justification for Proposed Project Site Selection
17. Complete Early Coordination Process for Permits
18. Complete Engineering Feasibility Report
19. Update Outdated Parameters and Address Information Gaps

### 3.3 Study Goals and Objectives

Evidence of water quality impairment in the Black Creek watershed is documented through photographs of sediment plumes, the presence of sediment deltas at the mouth of Black Creek's discharge into Hamilton Lake, the loss of trees and streambanks to erosion along Black Creek, and the need for lake residents to extend docks near Black Creek to support continued boat access. Given this evidence of water quality impairments DES has focused our efforts on the Black Creek watershed.

The goals and objectives of this study include the following:

- Determine the feasibility of construction sites for proposed structures and/or other pollution control activities such as Best Management Practices (BMPs).
- Complete necessary engineering activities and computations to complete the determination of engineering feasibility.
- Recommend structures and/or activities for implementation.

## 4.0 DESCRIPTION OF STUDY AREA

In general, information predominantly about the Black Creek watershed will be presented in this section since the scope of this study concentrates on the Black Creek watershed.

### 4.1 Location

Hamilton Lake is a natural lake located in Otsego Township in Steuben County in the northeastern corner of Indiana in the town of Hamilton (Figure 1). Hamilton Lake discharges over a dam into Fish Creek, a tributary of the St. Joseph River.

### 4.2 Lake and Watershed Characteristics

Hamilton Lake has a surface area of approximately 836 acres as computed from Geographic Information System (GIS) files obtained from the Steuben County GIS office. The Hamilton Lake watershed is located in the 14-digit hydrologic unit code (HUC) of 04100003050040 – Hamilton Lake/Black Creek. The Hamilton Lake watershed is approximately 10,600 acres, inclusive of Hamilton Lake (Figure 2). Figure 3 shows the lake and its bottom contours (bathymetry). The maximum depth of the lake is approximately 70 feet. Average depth has been reported to be approximately 21 feet (Harza, 1990). Lake volume, utilizing the above lake surface area and approximate average depth is 17,561 acre-feet.

The drainage from the Hamilton Lake watershed into Hamilton Lake is predominantly from three main inlets from the west, east, and northeast. Black Creek is by far the largest tributary to the lake. Black Creek drains approximately 6,104 acres or 63% of the total watershed (Figure 4).

### 4.2 Summary of Historical Studies

A Lake Enhancement Feasibility Study was performed for Hamilton Lake by Harza Engineering Company (Harza) in 1990. The major findings of this study were as follows:

- Hamilton Lake water quality is moderately alkaline and fertile.
- Grasslands, either in the form of Conservation Reserve Program (CRP) set-aside lands, hayfields, or other idle lands are the most common land use, with crop land second.
- Approximately 61% of the lake's total watershed is considered to be highly erodible land.
- Black Creek's watershed contains about 56% of the highly erodible soils in the watershed, with approximately 75% of this highly erodible land being used for row crop production.

- The empirical phosphorus model predicted a mean annual water column total phosphorus concentration of 0.044 mg/L, indicative of a eutrophic lake.
- The Harza study recommended construction of a series of wetlands in the watershed to trap sediments and their associated nutrients before discharge into the lake.

### 4.3 Soils

The Hamilton Lake watershed is primarily composed of Glynwood-Morley-Blount soils series, described as deep, nearly level to moderately sloping, well drains to very poorly drained, silty soils on till plains (SCS, 1981).

A detailed soil survey map for the lower portion of the Black Creek watershed is shown in Figure 5. Soils of interest are found along Black Creek from Hamilton Lake to County Road 600E. Soil types found in this area include:

- Co – Cohoctah sandy loam
- CaD2 – Casco gravelly sand loamy, 1 to 18 percent slopes, eroded
- KsC – Kosciusko gravelly sandy loam, 6 to 12 percent slopes
- BnA – Blount silt loam, 0 to 3 percent slopes
- Sh – Shoals loam
- Wa – Wallkill silt loam
- MoE2 – Morley silt loam, 18 to 25 percent slopes, eroded
- MoC2 – Morley silt loam, 6 to 12 percent slopes, eroded
- Mn – Milford silty clay loam

General descriptions of each of these soil types are included in Appendix A. In general, each of these identified soils is either silt, sand or clay loams, all of which pose no constructability issues.

### 4.4 Land Use and Topography

Land use in the watershed was reviewed from recent aerial photographs. Land use in the Black Creek watershed is primarily used for agricultural purposes, pasture or row crops. There are a number of CRP site and field buffers along Black Creek throughout the watershed. As Black Creek gets closer to Hamilton Lake a majority of the creek discharges through densely wooded forest land.

Topography in the Black Creek watershed consists predominantly of rolling hills. Elevations at the upper end of the Black Creek watershed are up to approximately 1,000 feet mean sea level (MSL) while those at the discharge of Black Creek into Hamilton Lake are approximately 900 feet MSL. Therefore, a change in elevation of approximately 100 feet occurs from the upper ends of the Black Creek watershed to the discharge at Hamilton Lake. A plot of a portion of Black Creek's stream gradient is provided in Appendix B. It can generally be seen that for the lower portion of the Black Creek watershed, stream slopes range from approximate 0.1 to 0.65% slope. The largest slopes are located from approximately Route 1 up to CR550E. It is in this lower section of the watershed where the most streambank erosion is evident, likely caused by high water velocities in this area.

### 4.5 Existing Watershed Enhancements

Historical and existing efforts have been attempted to improve the water quality that is discharging from Black Creek into Cedar Lake. In the late 1990s and early 2000s, a constructed wetland was installed along Haughey Ditch just before discharge into Black Creek. This was a LARE funded project. As can be seen in some habitat evaluations provided later in this report, this wetland appears to be having a positive impact on water quality and watershed habitat. However, no site-specific quantitative laboratory analysis data are available to provide for comparison and assessment purposes. Additionally, the Steuben County SWCD has invested a lot of resources (time and money) into enrolling land owners into the CRP program and stream buffer programs. Although no site-specific quantitative laboratory analysis data are available to provide for comparison and assessment purposes, it is evident that positives impacts on Black Creek water quality have occurred as streambanks are stable in the upper watershed and there is no wide spread evidence of gulley and rill erosion in fields along Black Creek.

## 5.0 IDENTIFICATION OF FEASIBLE PROJECTS

The scope of this project was to identify structures and/or BMPs to improve water quality discharging from Black Creek into Hamilton Lake. To do this, DES conducted a field survey of Black Creek and its major tributaries on April 25, 2006. Results of this survey including observations, pictures, maps, and recommendations are provided in detail in Appendix C. Applicable information from this appendix is included in this section.

### 5.1 Site Description and Alternatives

A number of locations, as shown in Figures 8, 9, 10, and 11, were identified where streambank stabilization would aid in reducing erosion directly into Black Creek. Site specific observations are detailed in Appendix C. Evidence of historical and current streambank erosion is evident in these areas. Approximately 650 feet of streambanks downstream of Route 1 (1,300 feet considering both streambanks) and approximately 450 feet of streambanks (one side of stream only) between Route 1 and CR550E should be stabilized utilizing harbor armoring and/or vegetative means. Conceptual drawings detailing common erosion control measures for eroding streambanks are shown in Figures 12 through 18. There techniques have a wide range of cost and complexity. Techniques include:

1. Simple erosion control matting which is designed to reduce shear stresses from water flow, which causes bank erosion (Figure 12). Stabilization with erosion control matting allows vegetation to establish on streambanks and provides a level of erosion protection greater than just vegetation and soil can by itself.
2. Cellular confinement or geocells are simply a “honeycomb” grid (generally constructed of plastic) that provides a stable framework or foundation in which soil and vegetation can be maintained and erosion potential reduced (Figure 13).
3. Coir rolls are circular “logs” constructed of coconut fiber, generally in twelve or 18” diameter rolls (Figure 14). These are placed at the “toe” of eroding streambanks and provide protection for this area which is exceptionally prone to erosion. Frequently, coir rolls are vegetated with native plants to provide habitat, improve aesthetics, and provide additional erosion protection.

4. Live staking is the practice of vegetating streambanks to provide erosion protection (Figure 15). Typical "staking" is performed with willow trees or other native shrubs and trees.
5. Rip-rap is a very common technique that is ubiquitously used (Figure 16). Rip-rap is the placement of large sized stones, specifically designed for site-specific stream flow velocities, to reduce erosion. Rip-rap is common because of its relatively low cost and ease of installation. It is generally not a favored technique in natural systems unless glacial stone is used as the rip-rap material. It is not favored as rip-rap provides little to no habitat value and it is not aesthetically pleasing.
6. Gabion baskets and mattresses are another possible stabilization technique (Figure 17). Gabions are large rocks and stones contained in a wire mesh basket. Baskets and mattresses can be made to order. Standard gabion mattress sizes are generally six inches thick, six feet wide, and lengths of nine or twelve feet. Gabion baskets generally have widths of three feet; lengths of six, nine, or twelve feet; and heights of one, 1.5, or three feet. These structures are very effective; however, they are expensive relative to other erosion protection measures. Unless soil is added on top of these baskets or they are vegetated in some way, they also provide little to no habitat benefit. However, they are generally more aesthetically pleasing than rip-rap and have far less operation and maintenance concerns.
7. Rock deflectors can be an effective technique for streams where there are significant bends and turns, such as Black Creek (Figure 18). Rock deflectors are designed to "deflect" flow away from the eroding streambank and to redirect it into the stream. "Deflectors" are typically constructed with rip-rap or gabions.

Sheet piling or seawall is another possible technique for streambank erosion protection. Sheet piling, as used to protect lake frontage, is a very effective erosion control technique. However, it is very expensive, provides no habitat value, and it would be very difficult to install in most locations in Black Creek as it requires significant heavy machinery for installation and Black Creek access is generally limited because of its forested habitat. Therefore, sheet piling is not considered feasible.

Grade control alternatives are conceptually shown in Figures 19 and 20. Grade control structures drop water from one level to another, preventing gouging out gullies or streambed erosion. They can also help to control flooding and trap the sediment moving with runoff water. Grade control structures are typically built across an existing gulley, a grassed waterway, or the outlet of a waterway. Grade control structures are most effective for 1$^{st}$ order streams or those smaller streams located in the upper reaches of the Black Creek watershed. Downstream sections of the Black Creek watershed will likely have storm stream flows and velocities that will preclude their use.

### 5.2 Land Availability Determination

For those areas where improvements are recommended, landowner information has been tabulated in Appendix D. Landowners have provided verbal authorization for enhancement on their properties with the understanding that design details would be

presented at a later date and negotiated with each individual landowner. DES will assist the HLA in obtaining the necessary easements from the landowners of interest.

### 5.3 Permit Requirements

Federal, state and local units of government have regulations related to the proposed BMPs and construction projects that may impact wetlands, floodplains, stream, rivers, and lakes. Early permit coordination was performed with the Indiana Department of Natural Resources and the U.S. Department of Interior, Fish and Wildlife Service (Appendix E).

#### 5.3.1 Federal Regulations and Permits

Section 404 of the Clean Water Act is the primary federal law regulating the discharge of dredged or fill material to waters of the United States. This law is embodied in federal regulations at 33 CFR Parts 320 through 331. The U.S. Army Corps of Engineers manages the permit program under Section 404 in cooperation with the U.S. Environmental Protection Agency. In Indiana, the Detroit District office issues 404 permits for the Black Creek watershed.

The Corps' determination of acceptability of any proposed discharge of dredged or fill material considers the probable environmental effect of the proposed discharge on the public interest. This determination typically involves checking compliance with:

- Endangered Species Act
- National Historic Preservation Act
- Fish and Wildlife Coordination Act
- Other federal laws
- State environmental regulations

Section 404 authorizations "Individual Permits" (IP), "Nationwide Permits" (NWP) or "Regional Permits". The type of permit required is determined according to the type of impact, the amount of impact, and the location of impact.

#### 5.3.2 State Regulations and Permits

The Indiana Department of Environmental Management (IDEM) and the IDNR are the principal state agencies for enforcing state environmental regulations. IDEM is responsible for providing water quality certification for discharges of dredged or fill material under Section 401 of the Clean Water Act. Without Section 401 Water Quality Certification (or a waiver of this certification), the Corps of Engineers (Corps) is not allowed to issue a Section 404 permit.

Projects requiring a Section 404 permit from the Corps, also require a 401 certification, or a waiver, by IDEM. Using the State's water quality standards as its guide (327 IAC 2), the Department determines if a proposed project will adversely affect the quality of the waters of the State. Under Section 401, the IDEM must act on a certification request within 60 days from the receipt of a complete application.

The Indiana Water Quality Standards (327 IAC 2) include policies of maintenance of existing uses and non-degradation of water quality. IDEM's granting of Section 401 Water Quality Certification (WQC) indicates that a proposed project will comply with the Standards. Certifications may include limitations, conditions or any other provisions, which IDEM deems necessary to assure that the Standards will not be violated. If IDEM has not given a blanket WQC for a particular NWP, then an individual WQC from IDEM will be necessary. For 404 NWP, the IDEM may have already granted a blanket certification with special conditions.

The IDNR requires a joint permit application for construction within a floodway of a stream or river, navigable waterway, public fresh water lake, and ditch reconstruction. The joint application can be used for: (1) alternation of the bed or shoreline of a public freshwater lake; (2) construction or reconstruction of any ditch or drain having a bottom depth lower than the normal water level of a freshwater lake of 10 acres or more and within ½ mile of the lake; (3) construction within the floodway of any river or stream; (4) placing, filling, or erecting a permanent structure in; water withdrawal from; or material extraction from; a navigable waterway; (5) extraction of mineral resources from or under the bed of a navigable waterway; and (6) construction of an access channel.

The IDEM Rule 5: Storm Water Runoff Associated with Construction Activity, is intended to reduce pollutants in storm water discharges into surface waters of the state. The requirements of Rule 5 apply to all persons who are involved in construction activity that results in the disturbance of one acre or more of land.

### 5.3.3 Local Permits

The Indiana Drainage Code gives county surveyors authority over “legal drains”. Legal drain status is maintained by the Steuben County Surveyor’s Office for areas of the Black Creek watershed upstream of CR550E. None of the proposed improvements are located on legal drains and they are therefore exempt from regulation by the Drainage Board.

**Table 5-1**

**PERMIT REQUIREMENTS**

| | Vegetative Filters | Check Dams | Bank Stabilization |
|---|---|---|---|
| Floodway Permit | n/a if not impacting Waters of the U.S. | If watershed above improvement > 1 $mi^2$ | If watershed above improvement > 1 $mi^2$ |
| 401 Certification | Possible | Required | Required |
| USACE Permit | Possible | Required | Required |
| IDEM Rule 5 | If BMP area > 1 ac | If BMP area > 1 ac | If BMP area > 1 ac |
| Dam Safety Permit | Possible | Required | Required |
| Drainage Permit | n/a | n/a | n/a |

## 5.4 Environmental Assessment

We have opted to mimic the guidelines of the U.S. Environmental Protection Agency's Clean Lakes Program in order to assess the environmental effects of proposed projects. These guidelines involve a checklist approach to impact assessment and can be found at 40 CFR, Part 35, Subpart H. These guidelines involve 14 questions that may be satisfactorily answered with a mere "Yes" or "No", but should detail important benefits or adverse effects sufficiently to allow for mitigation planning during the design and implementation phases.

Appendix F provides the results of the Environmental Assessment. None of the proposed projects have significant adverse effects on the physical, biological or social environment. The small scale of the proposed projects limit their adverse effects on environmental resources.

## 5.5 Habitat Evaluation

Appendix G includes a habitat evaluation of a number of locations throughout the Black Creek watershed. The locations and habitat evaluation scores are found on Figure 7. The habitat evaluation was performed utilizing the Citizens Qualitative Habitat Evaluation Index (CQHEI). This index was developed by the Ohio Environmental Protection Agency as a "Citizens" companion to the Qualitative Habitat Evaluation Index (QHEI) used by the state's professional staff (Hoosier Riverwatch, 2005). The purpose of the index is to provide a measure of the stream habitat and riparian health that generally corresponds to physical factors affecting fish and other aquatic life. The CQHEI produces a score that can be used to compare sites to each other or compare one site over time. Scores greater than 60 have been found to be "generally conducive to the existence of warmwater fauna."

As can be seen in Figure 7, generally the best habitat, as measured by the CQHEI, occurs in the lower reaches of Black Creek from approximately County Road 600E to Hamilton Lake. Additionally, the habitat in Haughey Ditch scores high also. Generally, the upper areas of the watershed score much lower.

## 5.6 Unusual Physical and Social Costs

Through the course of public meetings, residents of Hamilton Lake expressed concern that recommended solutions provide not only water quality benefits but also aesthetic benefits. The citizens expressed their desires to have something natural that could blend into and/or complement the existing landscape. The public also expressed concern of flooding that is prevalent throughout areas of the Hamilton Lake watershed.

No unusual physical or social costs have been identified for the identified enhancement projects. Including native plantings in the enhancement projects will add small costs to these projects, less than 15%.

## 5.7 Constructability

As has been previously mentioned, access to a number of proposed enhancement areas will be difficult for heavy construction equipment that would be most useful in performing a number of these recommended enhancement efforts (i.e. backhoes and large trucks). This is most prevalent in the highly wooded forested floodplains, which are densely wooded and in places have very high and steep bluffs. Permits issued for this project will very likely require minimal disturbance to the stream, streambed, and streambanks, which will preclude driving construction traffic up and down Black Creek. This would have been a historical accepted practice to allow easy access to a construction area. Therefore, it is possible that some access roads will need to be constructed in areas of the forested floodplain. This might include the cutting and removal of trees, the installation of culverts, or possibly the installation of access roads (grading and rock). Because of the limitations on access, the time and costs to perform this work will increase accordingly. As part of the permitting process, the permit engineer should understand these limitations and negotiate with the permitting authorities to gain access to work in the stream where it is not possible to perform enhancement efforts without some limited access to the stream and streambed.

Another important constructability constraint many times relates to utilities in and near proposed enhancement areas. The recommended enhancement alternatives presented herein do not include significant construction activities (deep foundation digging) which would impact buried utilities. In fact, the recommended enhancement activities are not known to occur near any public utilities. However, as part of the design and construction process, the engineer will be required to properly notify public utilities and request utility clearance. Additionally, the engineer should work closely with individually impacted landowners to ensure that any unknown utilities are not impacted. However, at this time, utilities are not considered a constructability issue for this project.

## 5.8 Budgetary Cost Estimates

This section tabulates budgetary costs based on DES's experience in similar types of projects. Costs presented herein are for budgetary purposes and will be modified and refined in design activities. Options for significant hard armoring have been presented below. Generally, because of high costs, these are very selectively utilized. Hence, for cost purposes, a unit cost has been presented; however, the budgetary cost estimate uses other less expensive armoring techniques.

| Item | # Units | Cost/Unit[1] | Budgetary Cost |
|---|---|---|---|
| Streambank Stabilization – Hard Armor[2] | | $150 / foot | |
| | | | |
| Streambank Stabilization – armor/vegetation | 1,750 linear feet | $75 / foot | $130,000 |
| Grade Control | 5 | $4,000/each | $20,000 |
| Native Vegetation | 5 | $1,000/each | $5,000 |
| Buffer Strips | 7 | $500/acre[3] | $3,500 |
| Mobilization/Demobilization | 1 | $5,000/unit | $5,000 |
| **Subtotal** | | | **$163,500** |
| Engineering @ 15% | | | $25,000 |
| Contract Administration @ 10% | | | $16,000 |
| Contingency @ 25% | | | $40,000 |
| **Total** | | | **$245,000** |

### 5.9 Project Justification and Estimation of Impact

The HLA is very interested in dredging and intends to apply for a LARE dredging grant. Dredging is a very expensive activity and one that you do not want to perform frequently. Therefore, it is important to control watershed sediment loading before dredging. The efforts identified above, once implemented, will reduce watershed sediment loading to Hamilton Lake.

## 6.0 CONCLUSIONS AND RECOMMENDATIONS

This study has presented watershed specific observations and identified sediment loads to Black Creek and ultimately Hamilton Lake. Specific locations to enhance water quality have been presented in the above sections.

Sediment deposition at the Black Creek discharge into Hamilton Lake is evident and is documented by many of the local residents. This deposition causes the following problems and impairments:

- Local residents can not access the lake without extending their docks.
- During many months of the year, fish and other aquatic species can not access Black Creek as they historically could.
- Sediment plumes and erosion in this area lead to an aesthetically unpleasing environment.

This study has identified enhancements, which will reduce new sediment loads to the lake. However, none of these enhancements will address the sediment that has built up over the years at the discharge of Black Creek into Hamilton Lake. Given access

[1] Given access constraints of the sites, costs will be higher than normal.
[2] Erosion protection measures such as sheet piling and gabion baskets are shown for comparison purposes.
[3] We have assumed a 30' wide buffer strip by 10,000 feet long total.

constraints of the sites, costs will be higher than normal to implement these water quality enhancement projects.

DES's recommendations are as follows:

- Address the sediment discharging into Hamilton Lake by constructing streambank stabilization in the areas noted in this study.
- Begin preparation of a Sediment Management Plan and grant preparation activities in preparation for limited spot dredging at the discharge of Black Creek into Hamilton Lake.
- Work with the Steuben County SWCD office to assist them in implementing watershed level practices such as buffer strips and grade control structures in the upper reaches of the watershed, with priority placed on recommended buffer strip locations identified in this study.

## 7.0 POTENTIAL FUNDING SOURCES

Funding agencies for similar types of projects include the branches of the United States Department of Agriculture (NRCS and the United States Forest Service), United States Department of Interior Fish and Wildlife Service, the United States Environmental Protection Agency, and the Corps. Many of these funding agencies provide money to the states, which in turn fund such programs as IDEM's Section 319 Nonpoint Source (NPS) Program. Other programs are financed at the state level, such as the LARE Program.

Not all the programs identified involve grants. Some provide long-term low interest loans to fund particular projects. In general, most of the programs require cost share requirements specifying non-federal contributions from 5 to 75%.

The most favorable sources of funding will likely be the LARE program, the 319 program and the Build Indiana program. HLA has had success winning grant money from the LARE program and should continue to explore this as a funding source. HLA should also consider applying for 319 program and Build Indiana funds however DES' experience suggests that these programs have many competing project types and are less inclined to fund needs similar to HLA's.

## 8.0 ACTION PLAN AND SCHEDULE

Overall the implementation of these projects will have several step-wise components:

- An application for design grants was prepared and submitted to the LARE office in January 2006.
- In August 2006 notice was provided that HLA was awarded a design project grant.
- In October 2006, HLA should solicit proposals from consultants to perform the design work.
- By the end of 2006, HLA should retain a consultant.
- In early 2007, the consultant should perform field investigations and related analyses. These efforts are needed to determine final design considerations including soils, surveying, and hydraulic impacts. This information is also needed

to facilitate approval of permits. Materials compiled in this stage of effort should be used to make submittals to permitting agencies.

- A key element of implementation involves property owner coordination. Agreements must be reached among the individual property owner(s) before any improvements can be implemented. This should begin in the fall of 2006.
- The last element of the implementation action plan is design of the improvement measures. This effort will focus on the design and the preparation of bid documents for the project. This can be finalized in the spring of 2007.
- Following completion of the project design documents and the bid tendering, the project can be constructed. This could conceivable begin as early as the fall or early winter of 2007.

The implement steps may vary slightly from the schedule described above depending on local decisions related to the configuration of the facilities, permitting issues, or other factors. The following tasks are recommended:

- Property Owner(s) Coordination (October 2006). Acceptance of the proposed plan by affected property owner(s) will be critically important to successful and timely project implementation. Using the concepts in this study, the HLA should continue discussions with property owners in the project area. These discussions should focus on the likely timing of developments and the need for individual owners to commit land area to the project. Results of these discussions will directly impact the final configuration of the proposed improvement. Surveying in and around the proposed enhancement locations will be required.
- Grant Application (January 2007). In order to have sufficient funds to construct the designed improvements and to meet the schedule outlined, HLA should apply to the IDNR LARE Program in order to secure sufficient funds to construct the designed improvements. Additionally the HLA might consider applying to the LARE program for sediment removal (dredging) funding.

**Table 8-1**

**ESTIMATED WATERSHED IMPROVEMENT SCHEDULE**

**Design Phase**

| | |
|---|---|
| LARE Grants Awarded | July 2006 |
| Consultant Proposals Requested | October 2006 |
| Finalize Land Easements | October 2006 – December 2006 |
| Detailed Design and Engineering | January 2007 – July 2007 |
| Surveying | February 2007 |
| Geotechnical Sampling and Analysis | February 2007 |
| Construction Grant Applications | January 2007 |

**Construction Phase**

| | |
|---|---|
| Grant Award | July 2007 |
| Construction Bids/Selection | September 2007 |
| Mobilization | September 2007 |
| Project Construction | September 2007 – November 2007 |

## 9.0 REFERENCES

Harza Engineering Company, 1990. Lake Enhancement Feasibility Study – Hamilton Lake, Indiana.

Hoosier Riverwatch, 2005. Volunteer Stream Monitoring Training Manual.

SCS (Soil Conservation Service) of the US Department of Agriculture, 1981. Soil Survey of Steuben County Indiana.

# FIGURES

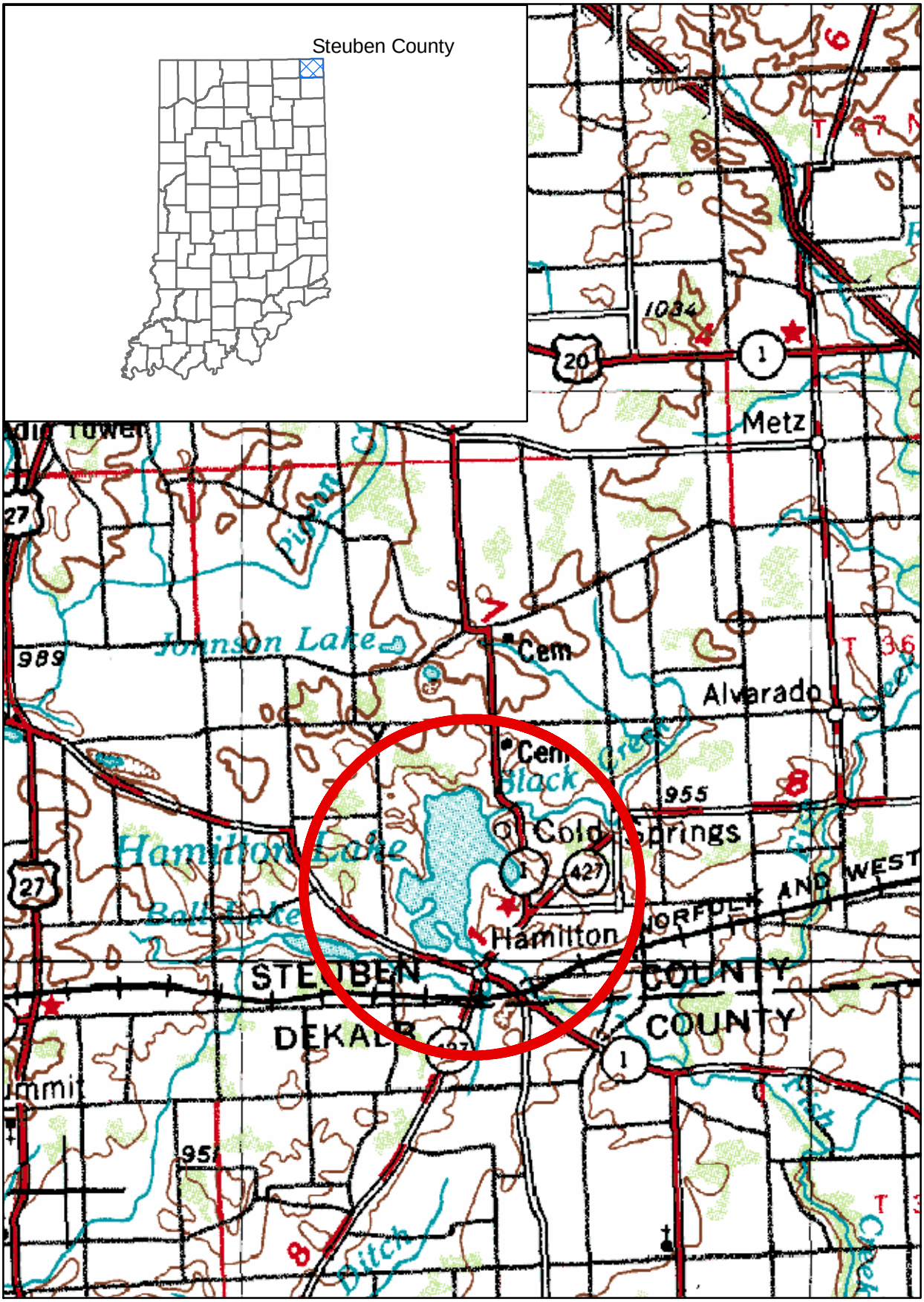



**Figure 1: Site Location Map**

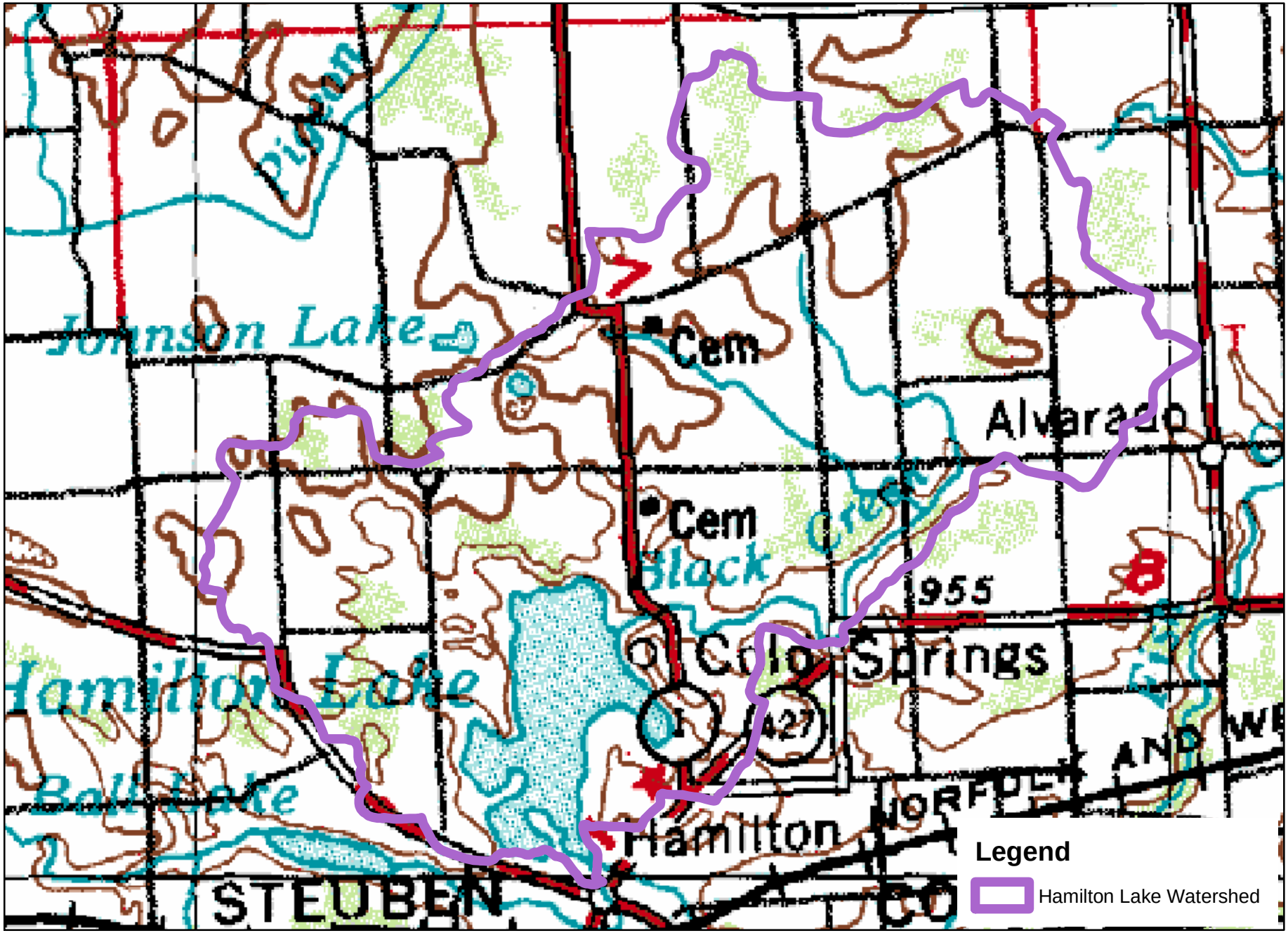



**Figure 2: Hamilton Lake Watershed Map**

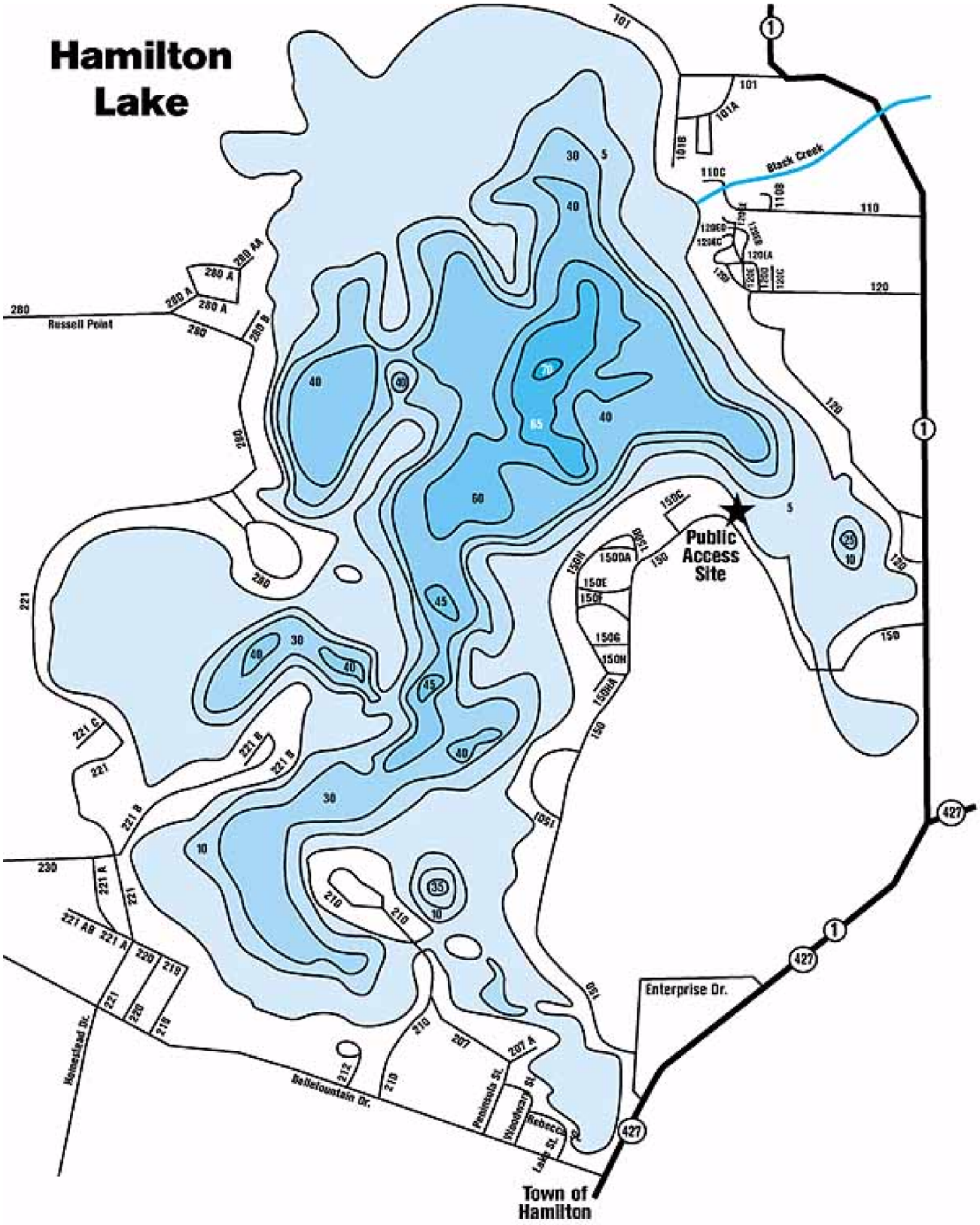



**Figure 3: Hamilton Lake Bathymetry**

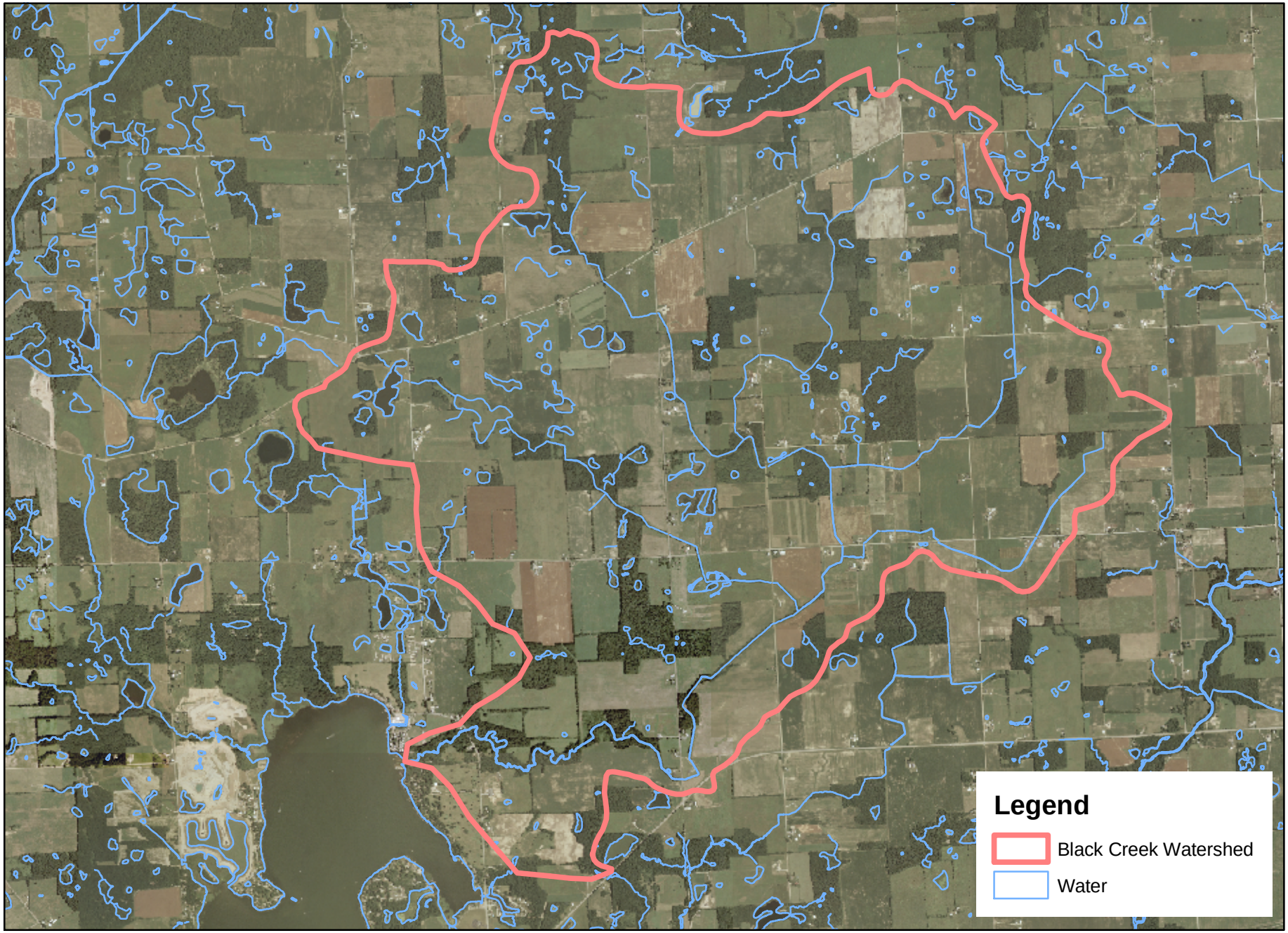



**Figure 4: Black Creek Watershed Map**

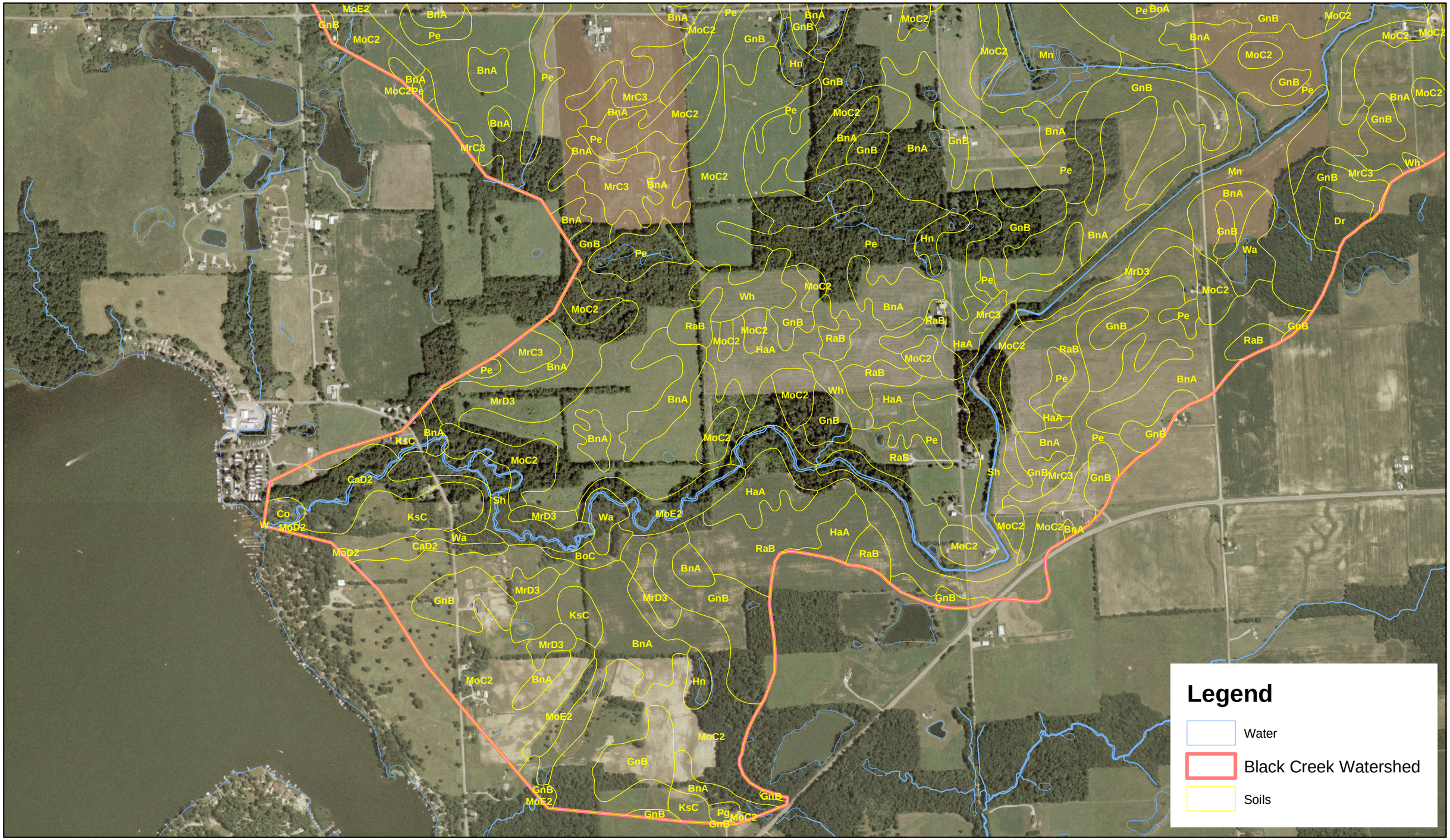



**Figure 5: Lower Black Creek Watershed Soils**

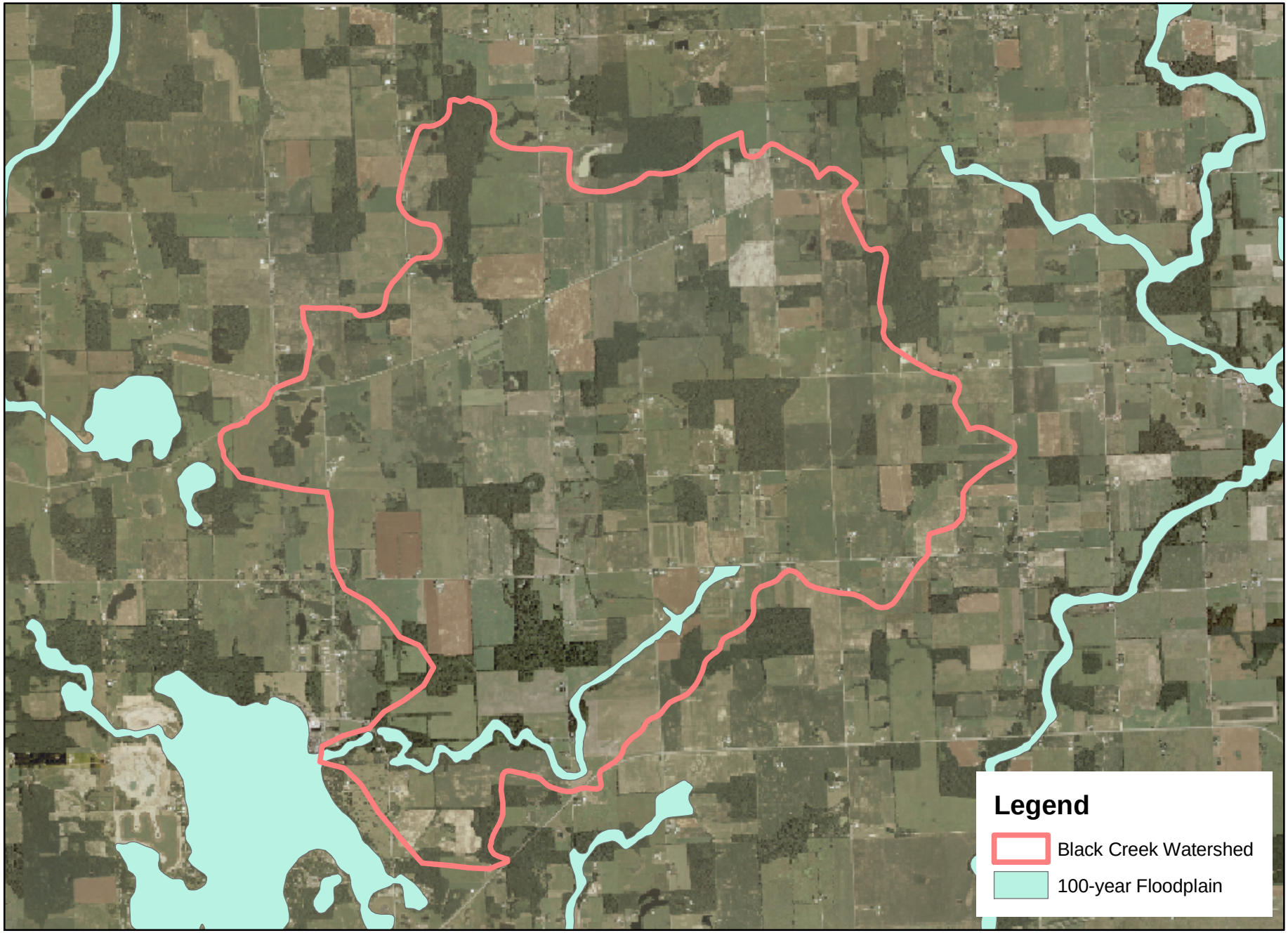



**Figure 6: Black Creek 100-year Floodplain Map**

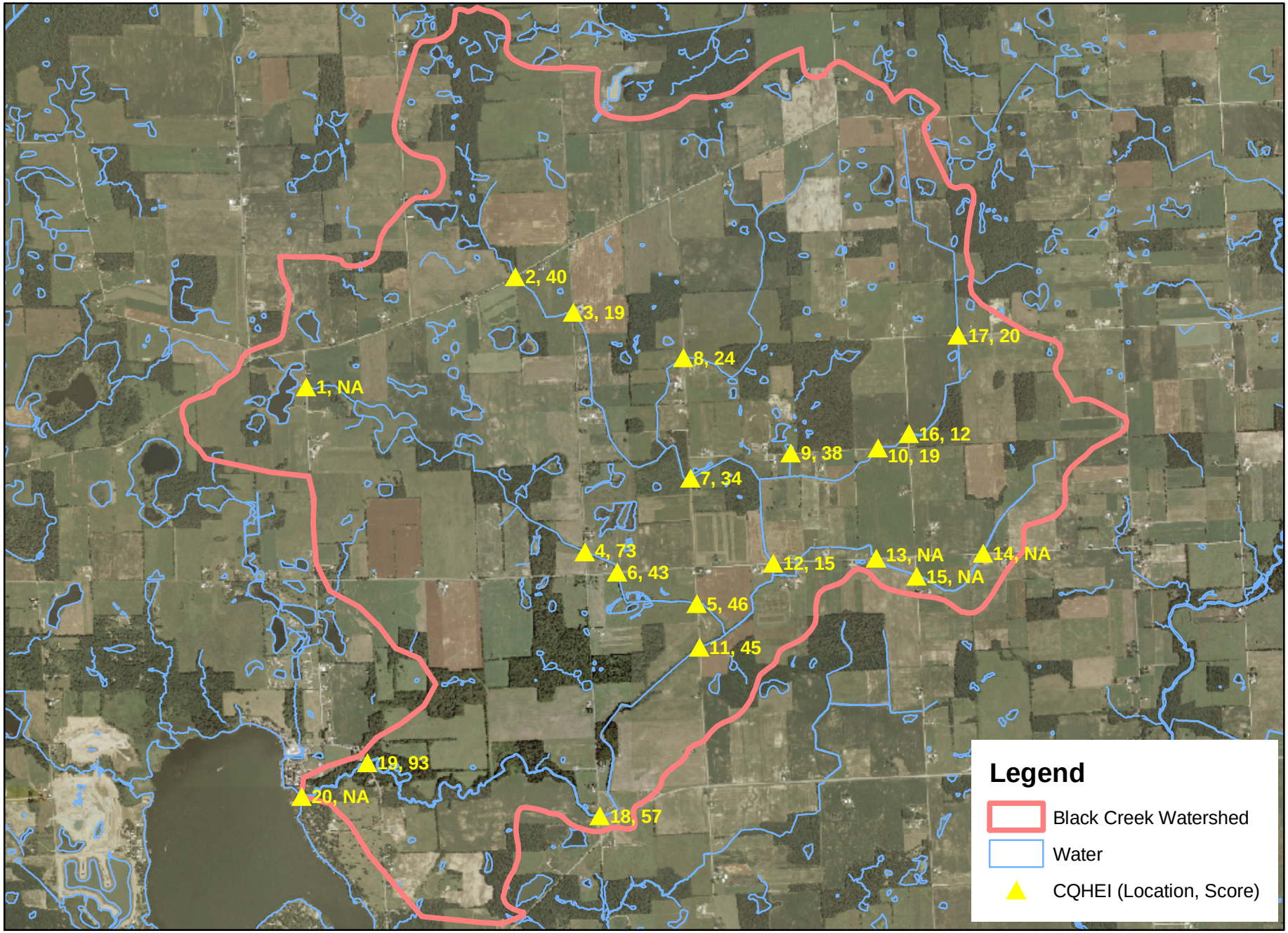



**Figure 7: Black Creek CQHEI Scores**

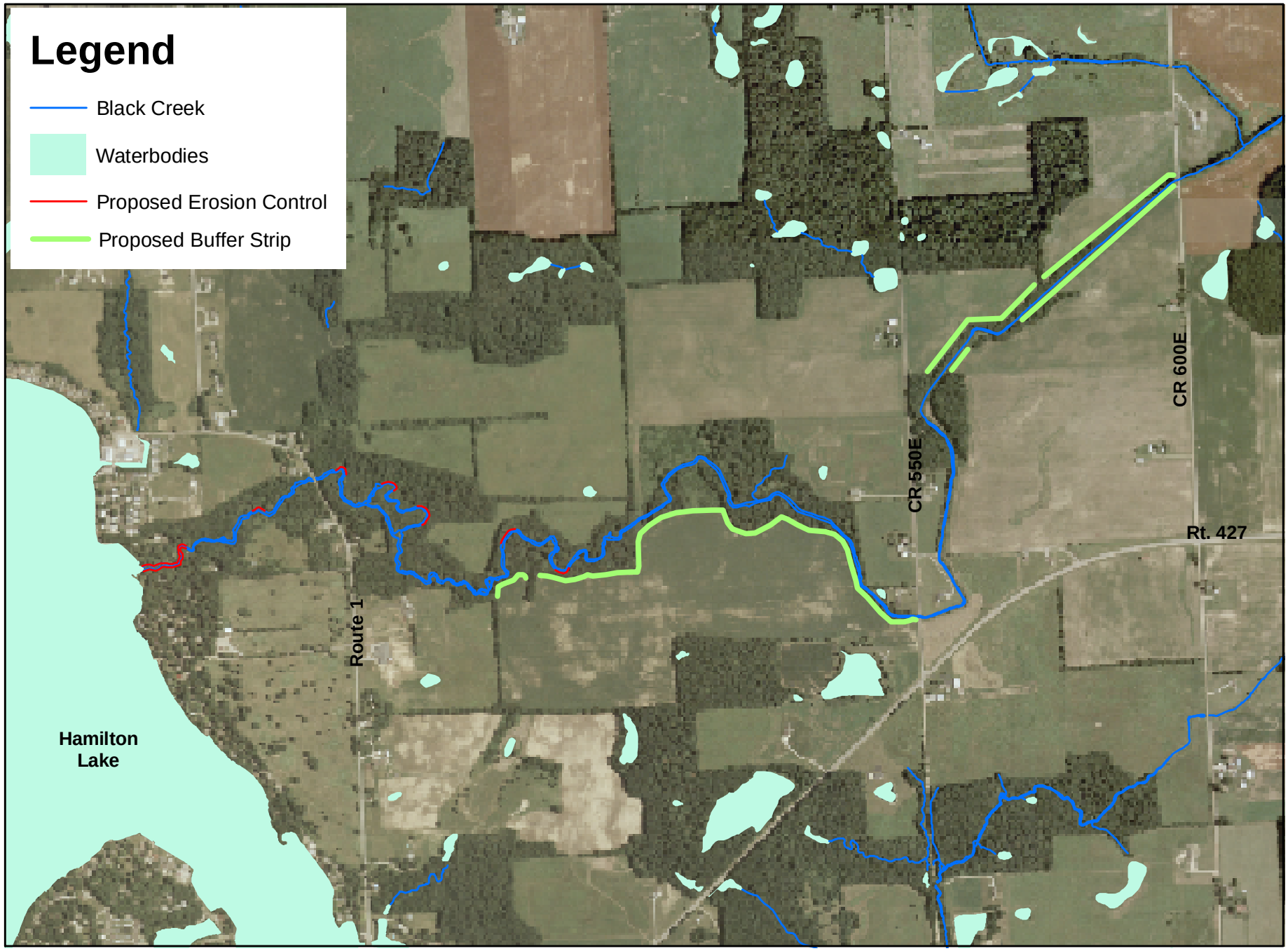



**Figure 8: Recommended Water Quality Enhancements Overview Map**

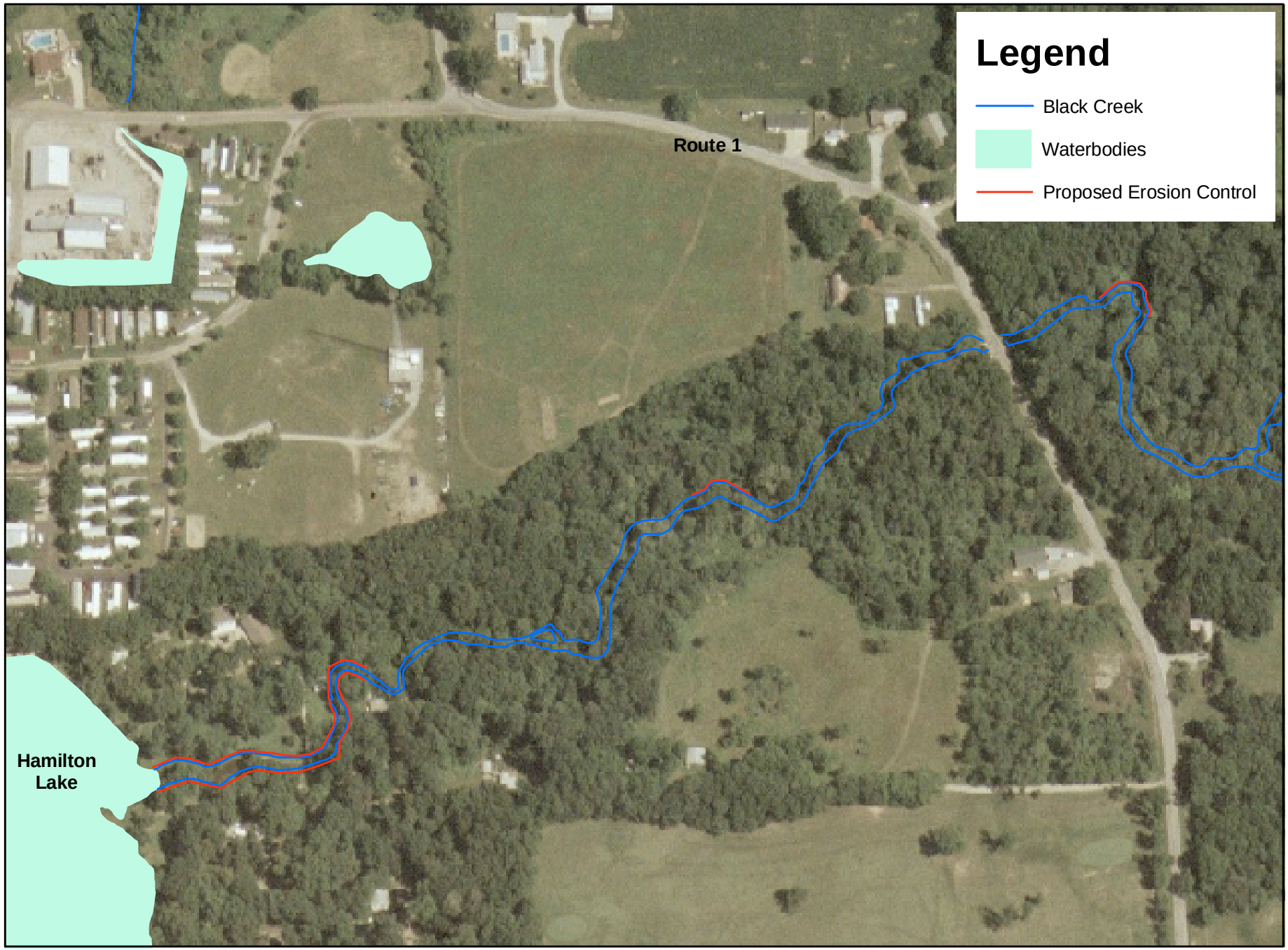



**Figure 9: Recommended Water Quality Enhancements Sheet 1**

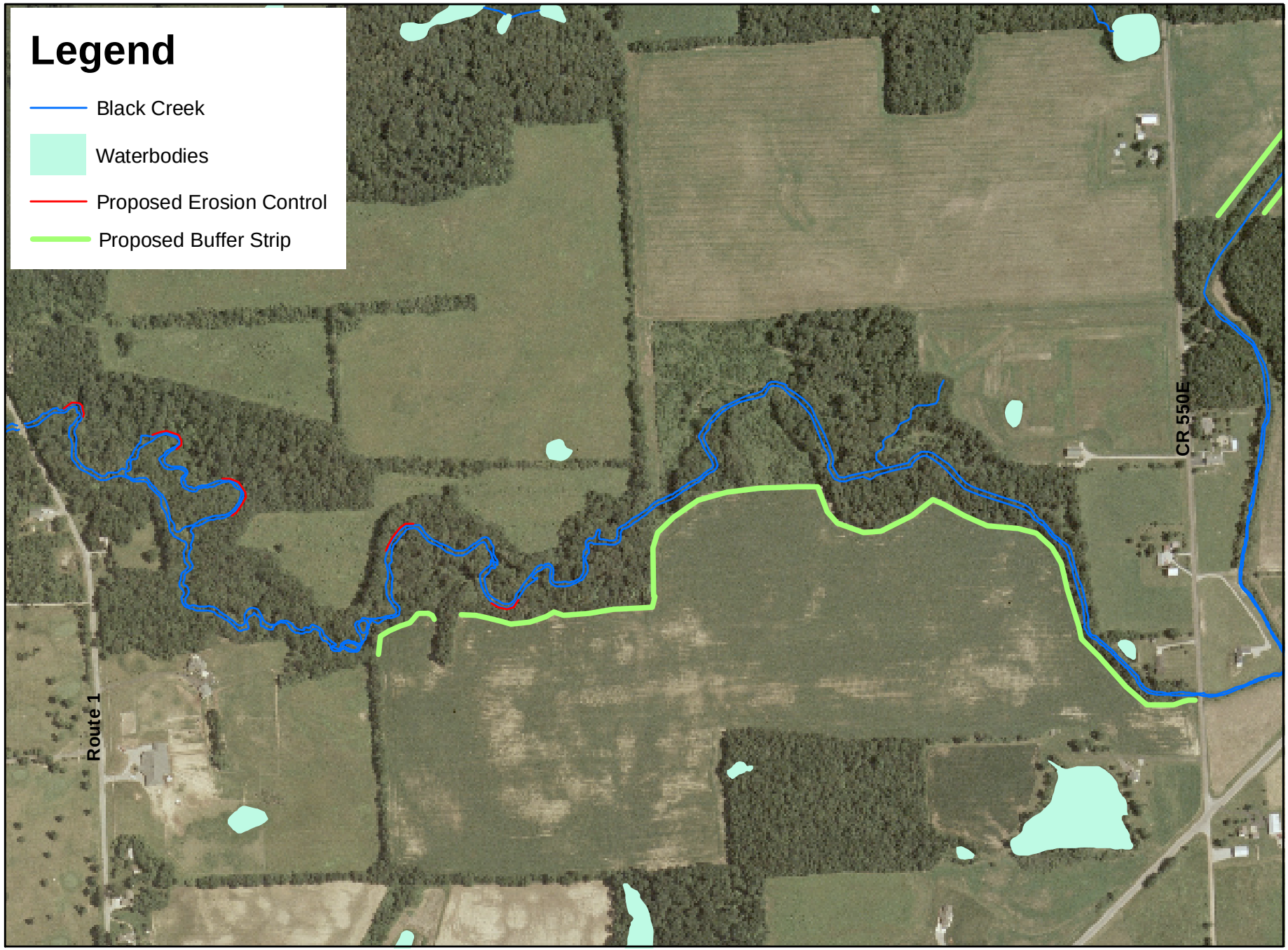



**Figure 10: Recommended Water Quality Enhancements Sheet 2**


**Figure 11: Recommended Water Quality Enhancements**
**Sheet 3**

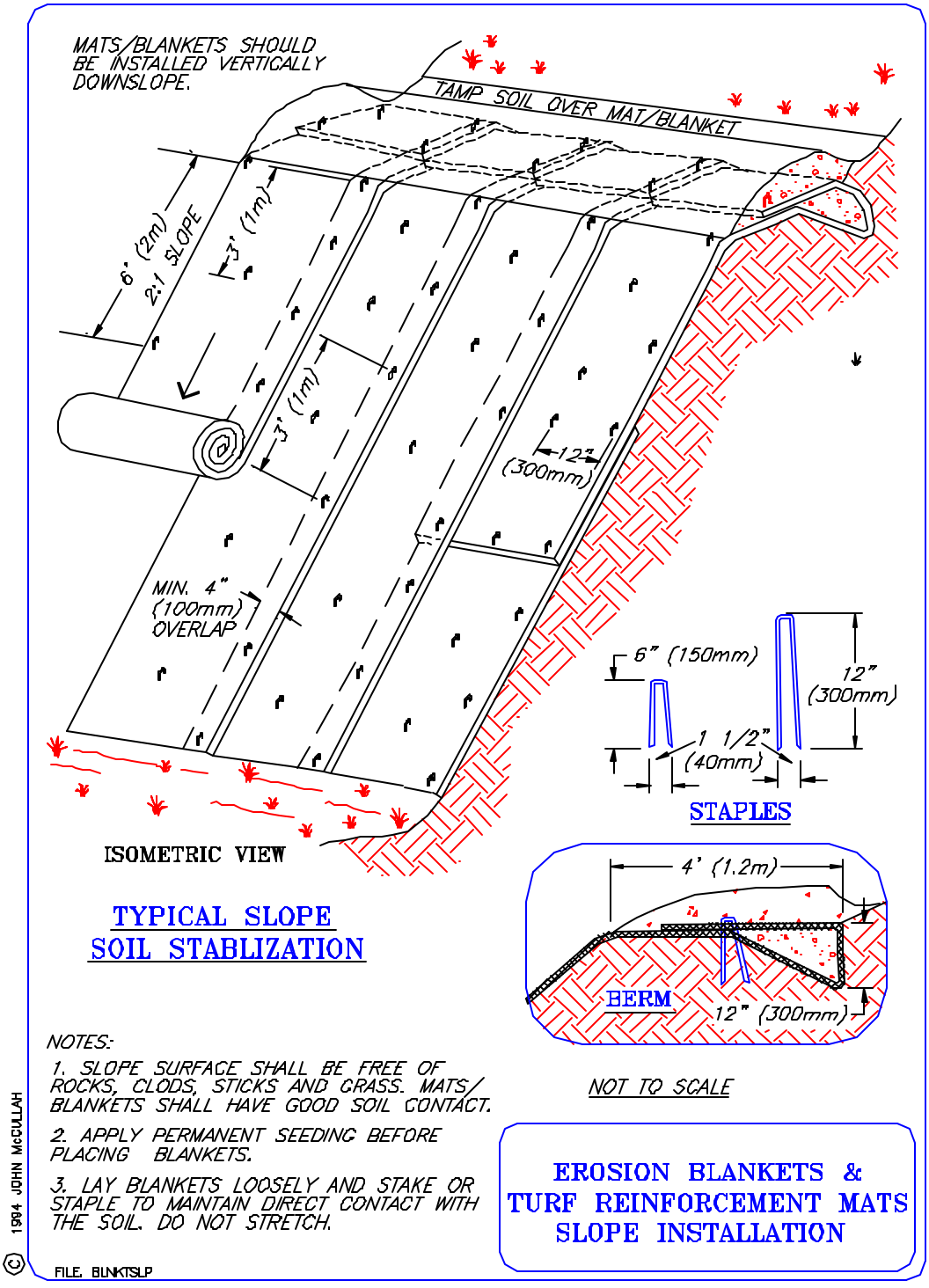



**Figure 12**
**Conceptual Streambank Stabilization Technique**
**Sheet 1**

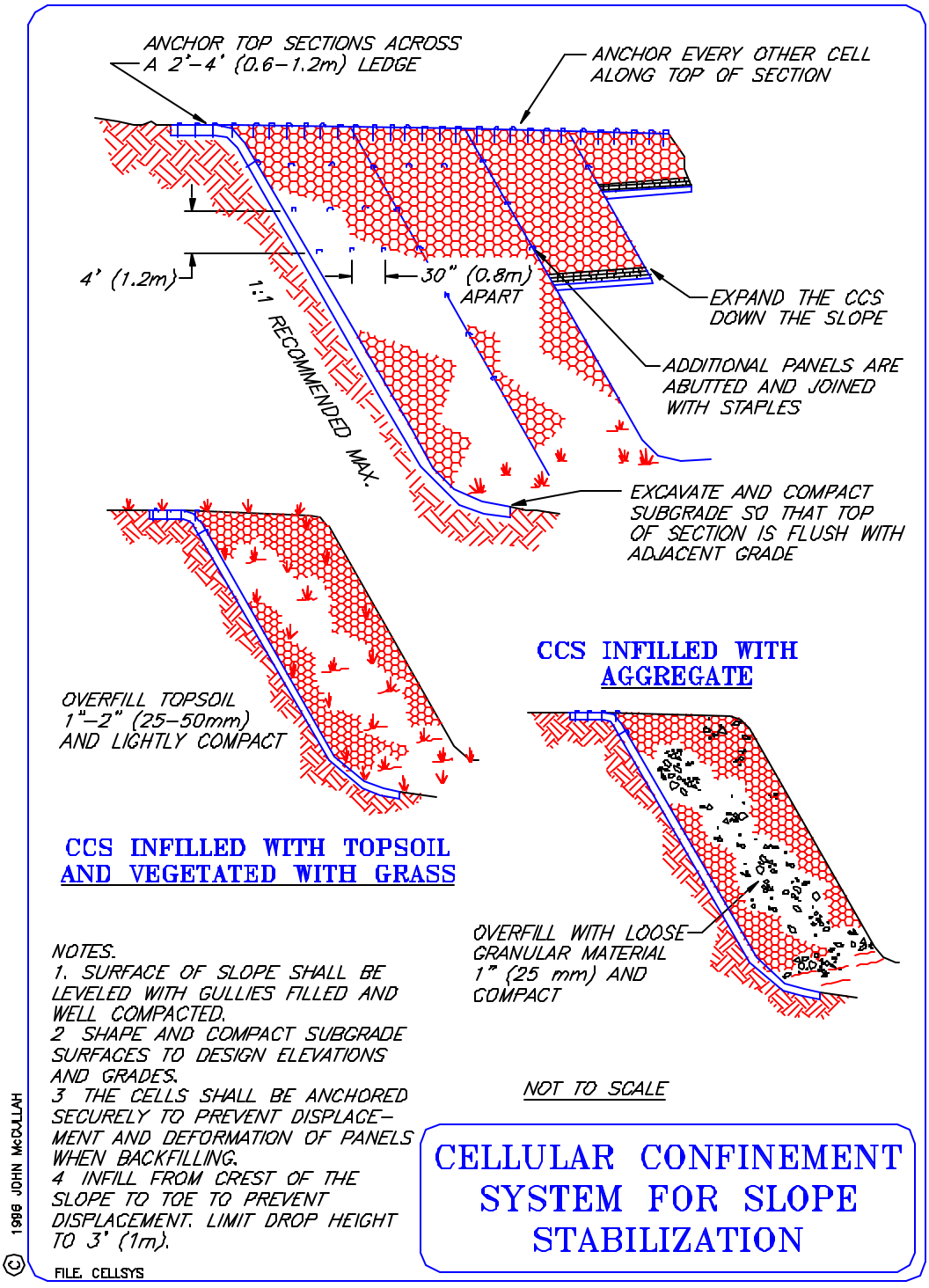



**Figure 13**
**Conceptual Streambank Stabilization Technique**
**Sheet 2**

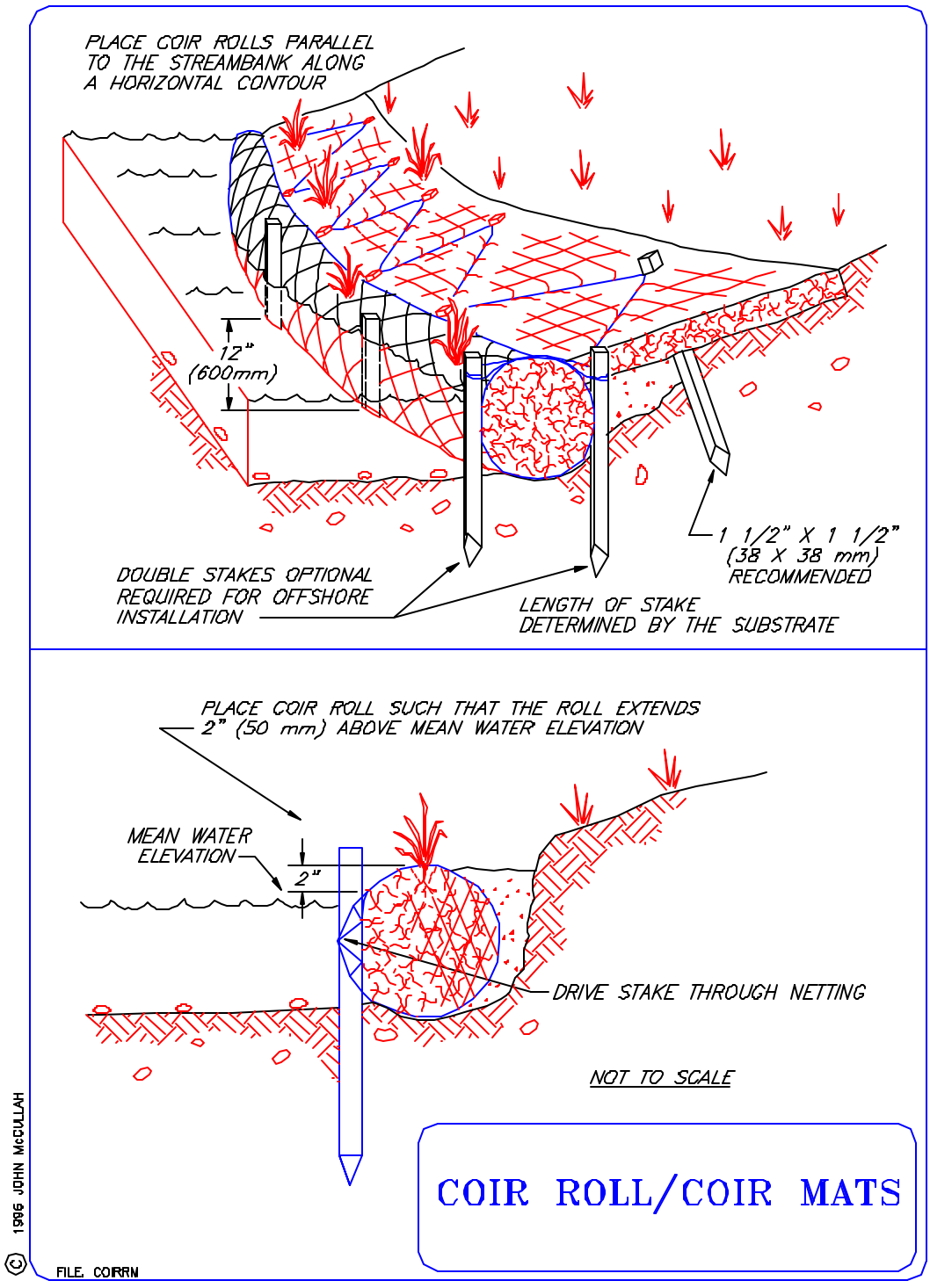



**Figure 14**
**Conceptual Streambank Stabilization Technique**
**Sheet 3**

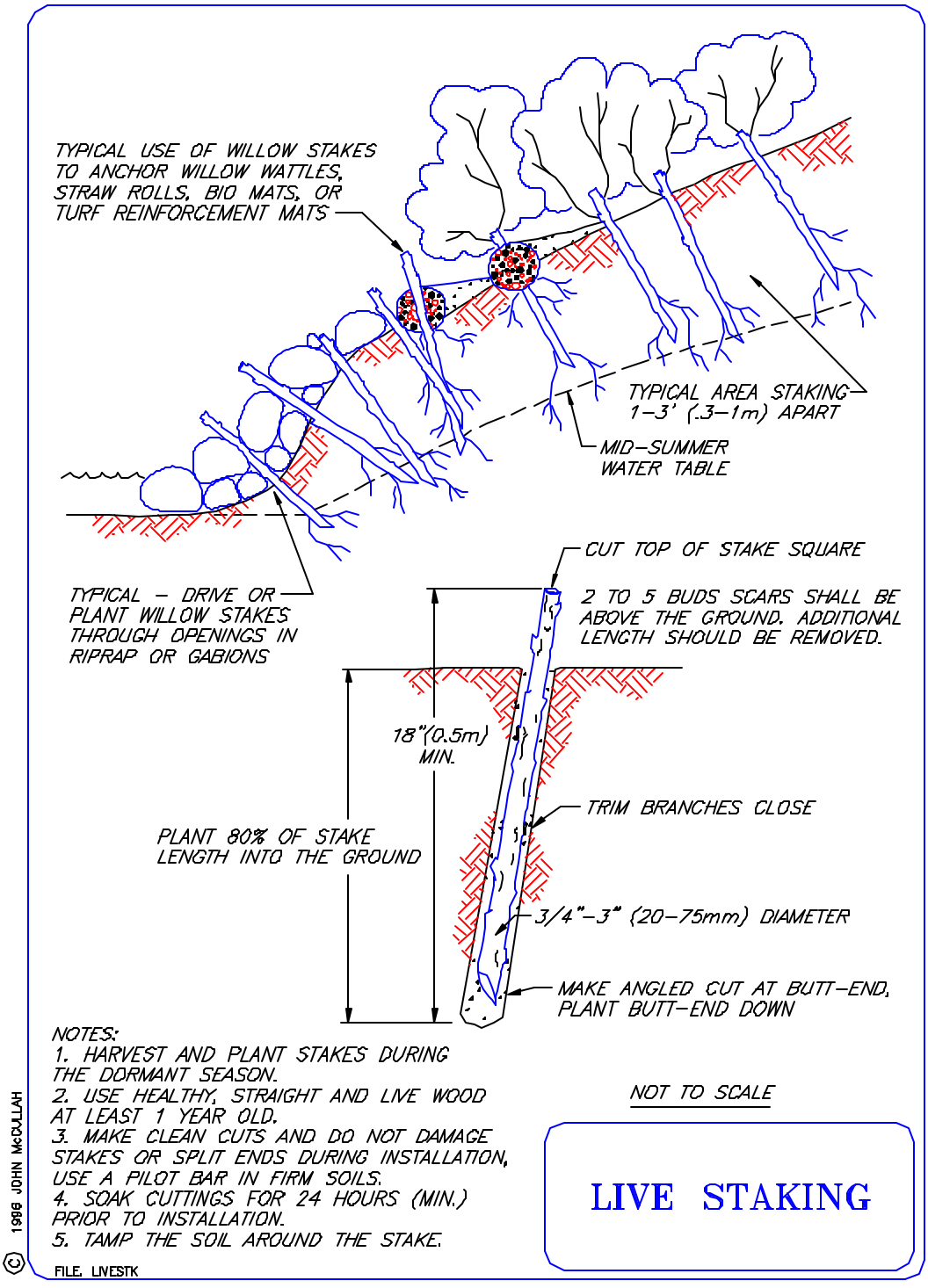
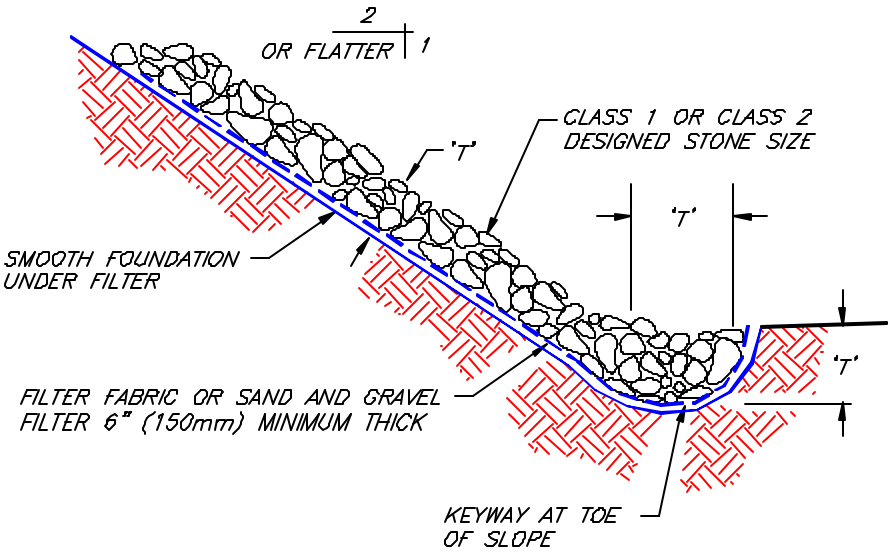



**Figure 15**
**Conceptual Streambank Stabilization Technique**
**Sheet 4**




TYPICAL SECTION

NOTE:
'T' = THICKNESS. THICKNESS SHALL BE DETERMINED BY THE ENGINEER.

MINIMUM THICKNESS SHALL BE 1.5x THE MAXIMUM STONE DIAMETER,
NEVER LESS THAN 6" (150mm)



FILE: RIPRAP

RIPRAP
PROTECTION

**Figure 16**
**Conceptual Streambank Stabilization Technique**
**Sheet 5**

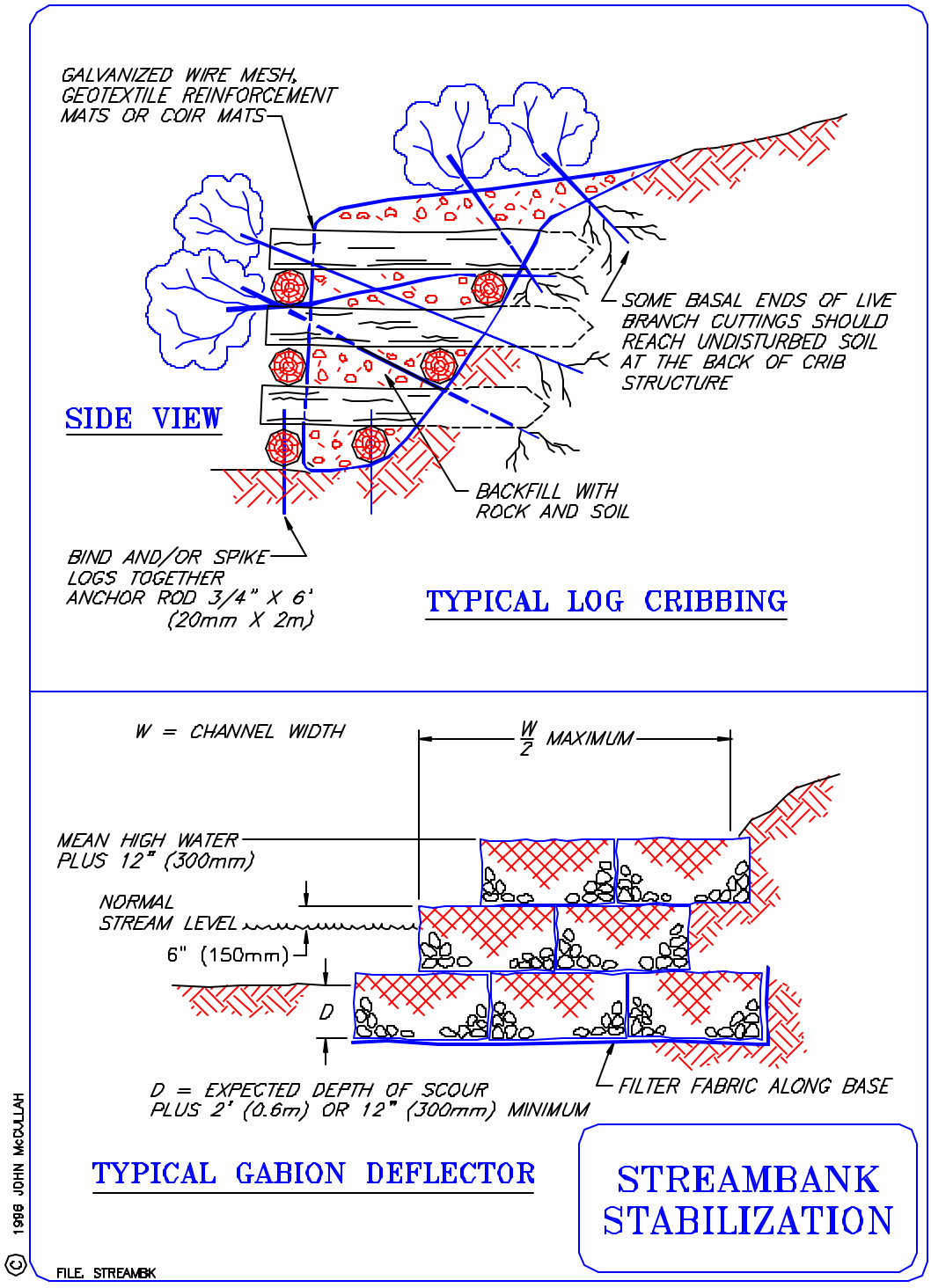



**Figure 17**
**Conceptual Streambank Stabilization Technique**
**Sheet 6**

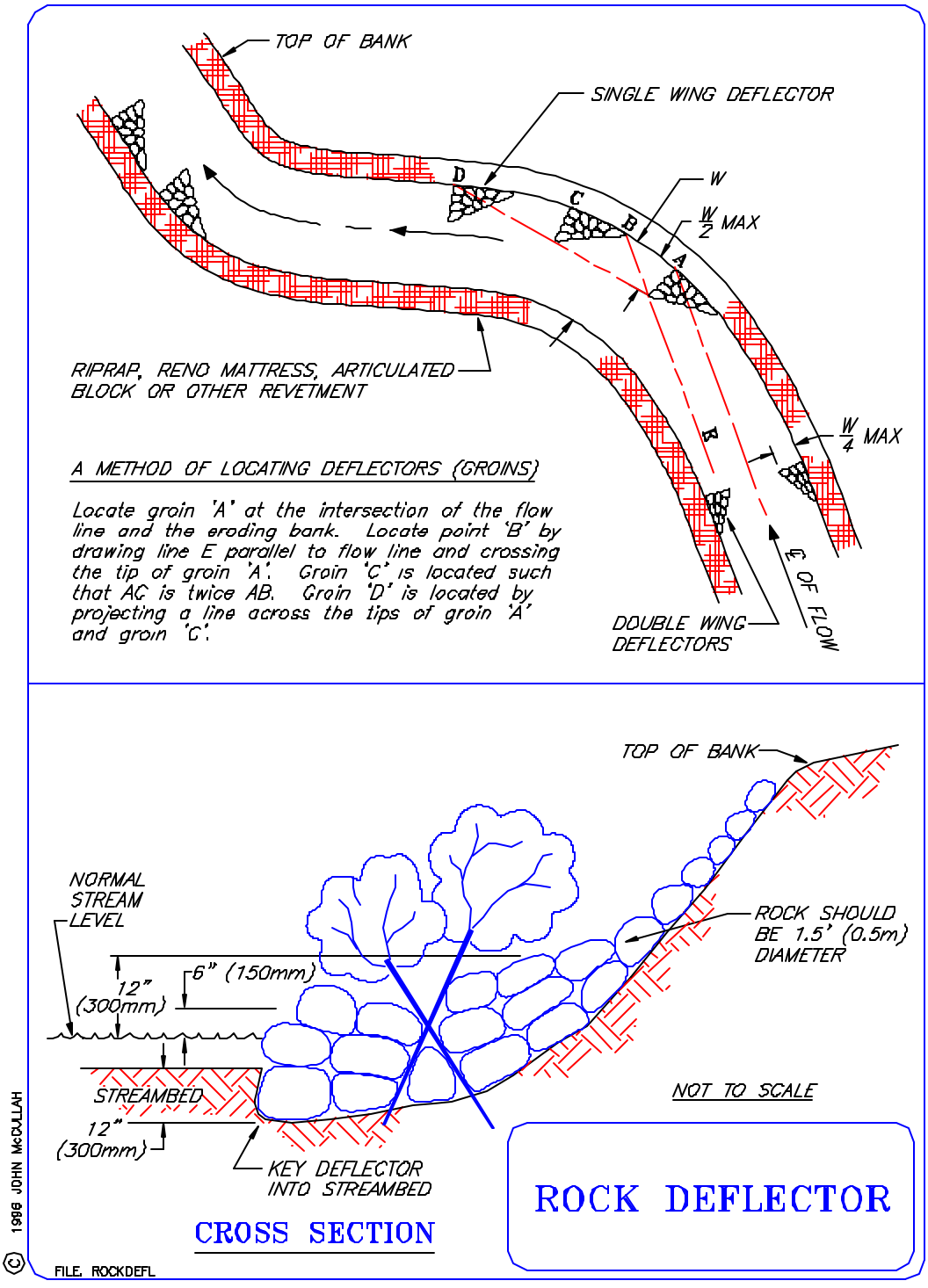



**Figure 18**
**Conceptual Streambank Stabilization Technique**
**Sheet 7**

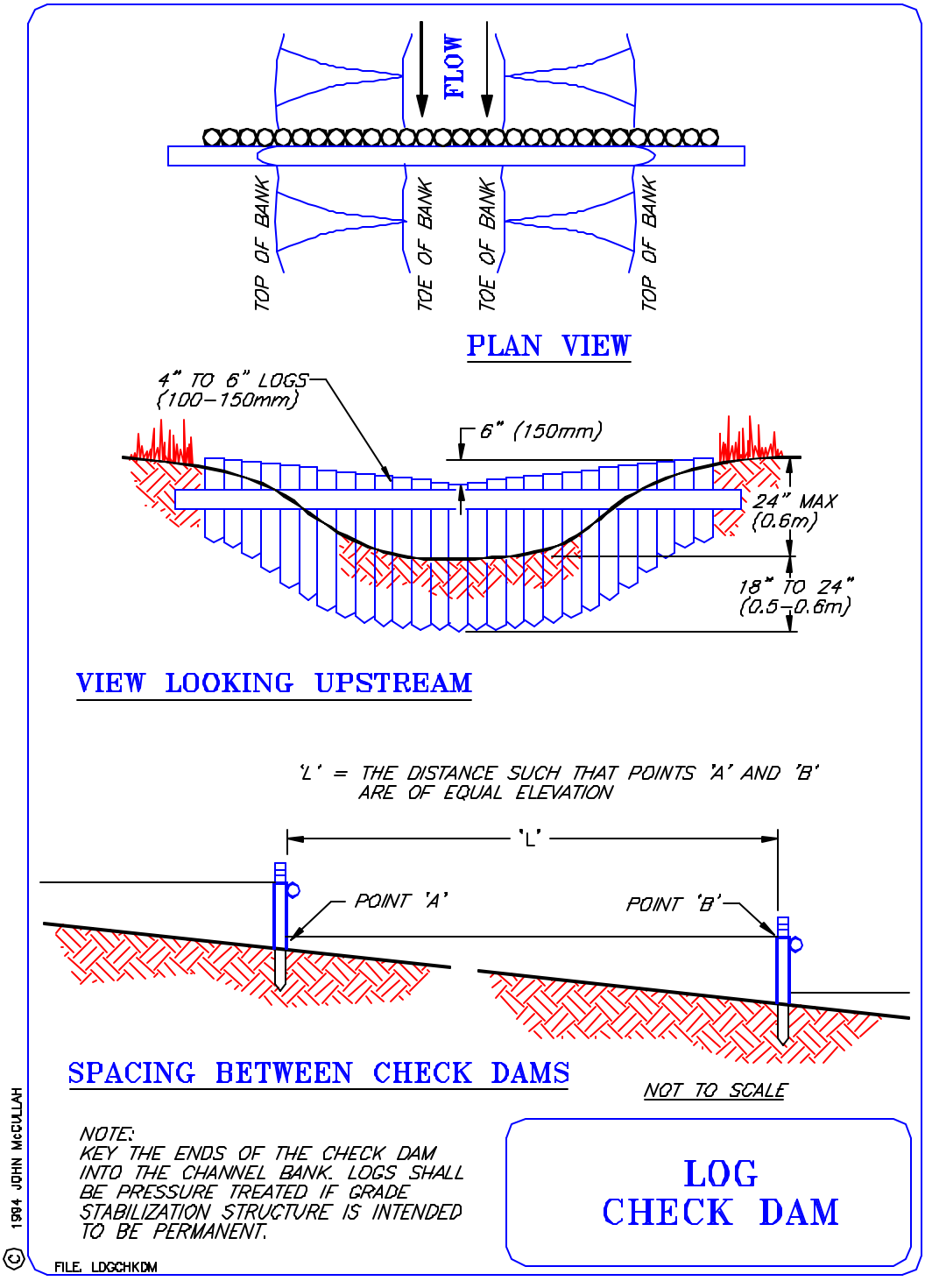



**Figure 19**
**Conceptual Stream Grade Control Technique**
**Sheet 1**

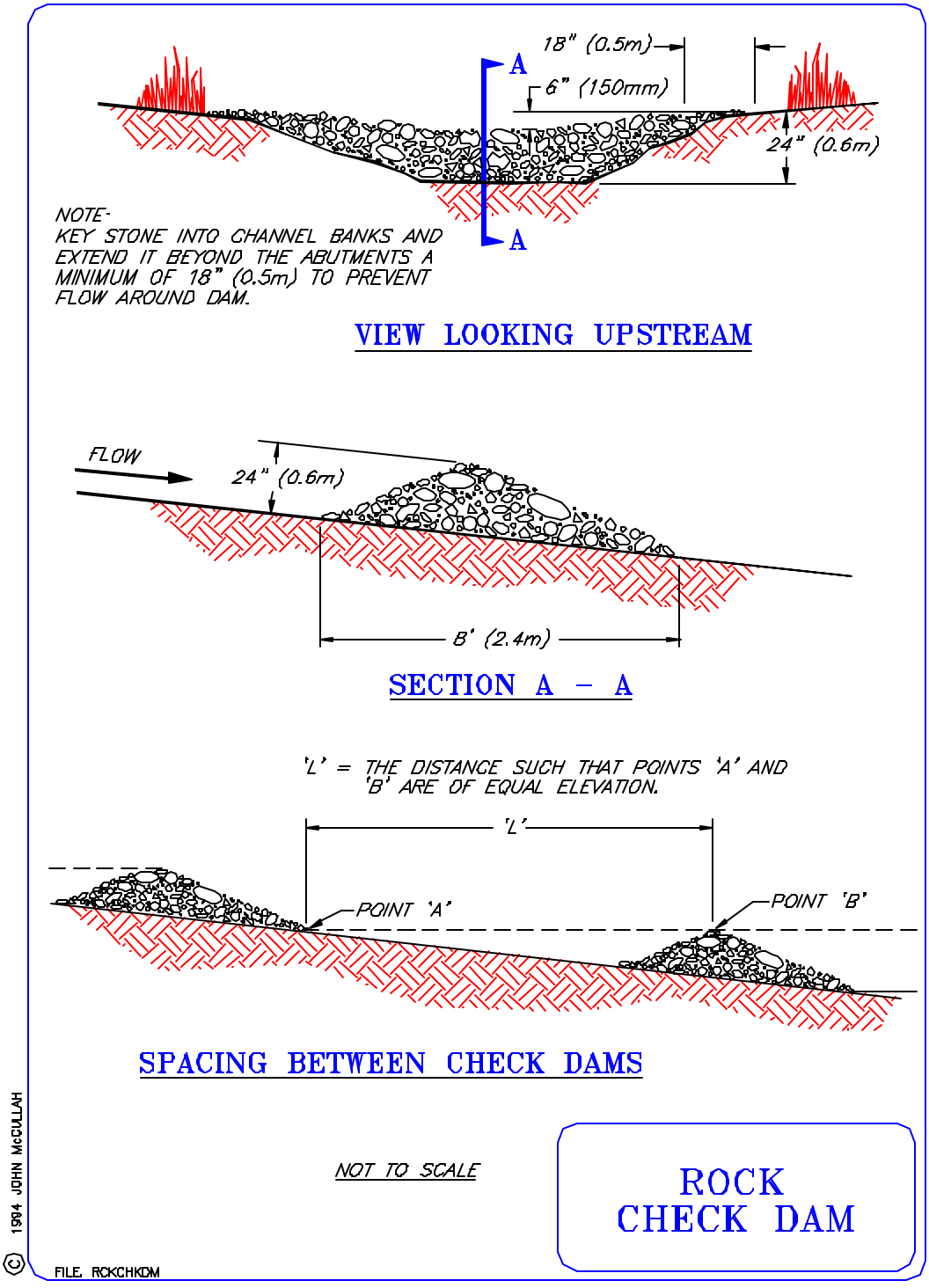



**Figure 20**
**Conceptual Stream Grade Control Technique**
**Sheet 2**

# APPENDICES

# APPENDIX A

# Component Text

Steuben County, Indiana

**Map unit:** Co - Cohoctah sandy loam

**Component:** Cohoctah

**Text kind/Category:** Nontechnical description/GENSOIL

*The Cohoctah component makes up 100 percent of the map unit. Slopes are 0 to 2 percent. This component is on flood plains. The parent material consists of loamy alluvium. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is very poorly drained. Water movement in the most restrictive layer is high. Available water to a depth of 60 inches is high. Shrink-swell potential is low. This soil is frequently flooded. It is frequently ponded. A seasonal zone of water saturation is at 3 inches during January, February, March, April, May, November, December. Organic matter content in the surface horizon is about 4 percent. Nonirrigated land capability classification is 3w. This soil meets hydric criteria. The calcium carbonate equivalent within 40 inches, typically, does not exceed 10 percent.*

# Component Text

Steuben County, Indiana

**Map unit:** CaD2 - Casco gravelly sandy loam, 12 to 18 percent slopes, eroded

**Component:** Casco

**Text kind/Category:** Nontechnical description/GENSOIL

*The Casco component makes up 100 percent of the map unit. Slopes are 12 to 18 percent. This component is on outwash plains. The parent material consists of loamy outwash over sandy and gravelly outwash. Depth to a root restrictive layer, strongly contrasting textural stratification, is 10 to 20 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is very low. Shrink-swell potential is moderate. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 2 percent. Nonirrigated land capability classification is 6e. This soil does not meet hydric criteria. The calcium carbonate equivalent within 40 inches, typically, does not exceed 40 percent.*

# Component Text

Steuben County, Indiana

**Map unit:** KsC - Kosciusko gravelly sandy loam, 6 to 12 percent slopes

**Component:** Kosciusko

**Text kind/Category:** Nontechnical description/GENSOIL

*The Kosciusko component makes up 100 percent of the map unit. Slopes are 6 to 12 percent. This component is on outwash plains. The parent material consists of gravelly loamy outwash over sandy and gravelly outwash. Depth to a root restrictive layer, strongly contrasting textural stratification, is 24 to 40 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is low. Shrink-swell potential is moderate. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 2 percent. Nonirrigated land capability classification is 3e. This soil does not meet hydric criteria. The calcium carbonate equivalent within 40 inches, typically, does not exceed 30 percent.*

# Component Text

Steuben County, Indiana

**Map unit:** BnA - Blount silt loam, 0 to 3 percent slopes

**Component:** Blount

**Text kind/Category:** Nontechnical description/GENSOIL

*The Blount component makes up 90 percent of the map unit. Slopes are 0 to 3 percent. This component is on till plains. The parent material consists of loess over clayey till. Depth to a root restrictive layer, densic material, is 30 to 60 inches. The natural drainage class is somewhat poorly drained. Water movement in the most restrictive layer is moderately low. Available water to a depth of 60 inches is low. Shrink-swell potential is high. This soil is not flooded. It is not ponded. A seasonal zone of water saturation is at 15 inches during January, February, March, April, December. Organic matter content in the surface horizon is about 2 percent. Nonirrigated land capability classification is 2w. This soil does not meet hydric criteria. The calcium carbonate equivalent within 40 inches, typically, does not exceed 28 percent.*

# Component Text

Steuben County, Indiana

**Map unit:** Sh - Shoals loam

**Component:** Shoals

**Text kind/Category:** Nontechnical description/GENSOIL

*The Shoals component makes up 90 percent of the map unit. Slopes are 0 to 2 percent. This component is on flood plains. The parent material consists of loamy alluvium. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is somewhat poorly drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is high. Shrink-swell potential is low. This soil is frequently flooded. It is not ponded. A seasonal zone of water saturation is at 15 inches during January, February, March, April, December. Organic matter content in the surface horizon is about 2 percent. Nonirrigated land capability classification is 2w. This soil does not meet hydric criteria. The calcium carbonate equivalent within 40 inches, typically, does not exceed 15 percent.*

# Component Text

Steuben County, Indiana

**Map unit:** Wa - Wallkill silt loam

**Component:** Wallkill

**Text kind/Category:** Nontechnical description/GENSOIL

*The Wallkill component makes up 100 percent of the map unit. Slopes are 0 to 2 percent. This component is on depressions on till plains. The parent material consists of loamy slope alluvium over herbaceous organic material. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is very poorly drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is very high. Shrink-swell potential is low. This soil is not flooded. It is frequently ponded. A seasonal zone of water saturation is at 3 inches during January, February, March, April, May, November, December. Organic matter content in the surface horizon is about 2 percent. Nonirrigated land capability classification is 3w. This soil meets hydric criteria.*

# Component Text

Steuben County, Indiana

**Map unit:** MoE2 - Morley silt loam, 18 to 25 percent slopes, eroded

**Component:** Morley

**Text kind/Category:** Nontechnical description/GENSOIL

*The Morley component makes up 100 percent of the map unit. Slopes are 18 to 25 percent. This component is on till plains. The parent material consists of loess over clayey till. Depth to a root restrictive layer, densic material, is 20 to 40 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately low. Available water to a depth of 60 inches is low. Shrink-swell potential is high. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 2 percent. Nonirrigated land capability classification is 6e. This soil does not meet hydric criteria. The calcium carbonate equivalent within 40 inches, typically, does not exceed 28 percent.*

# Component Text

Steuben County, Indiana

**Map unit:** MoC2 - Morley silt loam, 6 to 12 percent slopes, eroded

**Component:** Morley

**Text kind/Category:** Nontechnical description/GENSOIL

*The Morley component makes up 100 percent of the map unit. Slopes are 6 to 12 percent. This component is on till plains. The parent material consists of loess over clayey till. Depth to a root restrictive layer, densic material, is 20 to 40 inches. The natural drainage class is moderately well drained. Water movement in the most restrictive layer is moderately low. Available water to a depth of 60 inches is low. Shrink-swell potential is high. This soil is not flooded. It is not ponded. A seasonal zone of water saturation is at 33 inches during January, February, March, April, December. Organic matter content in the surface horizon is about 2 percent. Nonirrigated land capability classification is 4e. This soil does not meet hydric criteria. The calcium carbonate equivalent within 40 inches, typically, does not exceed 28 percent.*

# Component Text

Steuben County, Indiana

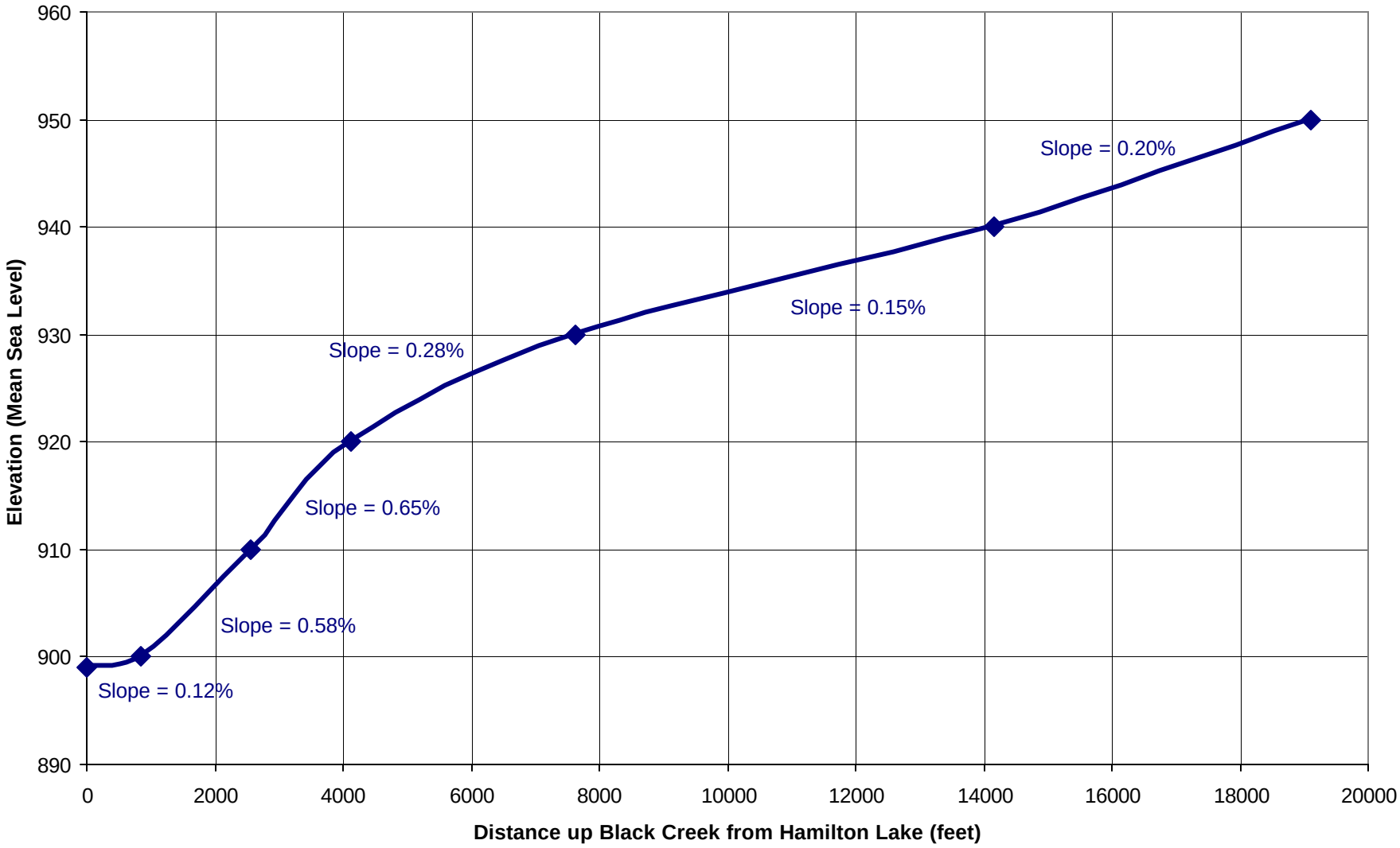
**Map unit:** Mn - Milford silty clay loam

**Component:** Milford

**Text kind/Category:** Nontechnical description/GENSOIL

*The Milford component makes up 100 percent of the map unit. Slopes are 0 to 2 percent. This component is on depressions on lake plains. The parent material consists of clayey lacustrine deposits. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is very poorly drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is high. Shrink-swell potential is high. This soil is not flooded. It is frequently ponded. A seasonal zone of water saturation is at 3 inches during January, February, March, April, May, November, December. Organic matter content in the surface horizon is about 4 percent. Nonirrigated land capability classification is 2w. This soil meets hydric criteria. The calcium carbonate equivalent within 40 inches, typically, does not exceed 10 percent.*

# APPENDIX B


Black Creek Gradient
960
950
940
930
920
910
900
890
Elevation (Mean Sea Level)
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000
Distance up Black Creek from Hamilton Lake (feet)
Slope = 0.12%
Slope = 0.58%
Slope = 0.65%
Slope = 0.28%
Slope = 0.15%
Slope = 0.20%

# APPENDIX C

# Memorandum

**Date:** 4/25/06

**To:** Hamilton Lake Association

**Cc:** Kent Tracey, LARE

**From:** Doug Mulvey

**RE:** Black Creek Technical Memorandum

---

The following are my observations from the Black Creek watershed reconnaissance performed on April 15, 2006 with members of the Hamilton Lake Association and interested local landowners. The lower section of Black Creek from Hamilton Lake to CR 550E was walked while the remainder of the watershed was reviewed from the roads and other public access sites.

The following attachments are included with this memorandum:

Appendix A – Lower Black Creek Property Owner Maps
Appendix B – Photo Log of the Lower Black Creek Walk
Appendix C – Black Creek Watershed Reconnaissance Photo Log
Appendix D – Recommended Water Quality Enhancement Overview Maps

The following observations were made during reconnaissance of Black Creek and its watershed:

**Black Creek – Hamilton Lake to Route 1**

Reference is made to Appendix A and B. The section of Black Creek from Hamilton Lake to Route 1 is predominantly a natural high quality section of creek. There are many riffles, runs, and pools as one moves away from Hamilton Lake towards Route 1. In general, this entire section of stream is surrounded by a high quality wooded floodplain. At the discharge of Black Creek into Hamilton Lake these is evidence of an extensive delta of sediment that has built up through the years. This delta of sediment prevent boat access by property owners in this area and prevents access of fish to Black Creek during dryer months. The sediment has likely flushed into the lake during high flow events leadings to sediment plumes documented by local landowners. Locals have identified the flood of 1996 as a major source of sediment and damage in the watershed.

Just upstream of the Black Creek, along the Kreinbrink, Spence, Lusch, and Byers properties, there is evidence of significant streambank erosion. This includes about 500 feet of streambank;

however, approximately 100 feet of this has been adequately protected on the Kreinbrink property with rip-rap. Some of the other properties along this stretch of stream have placed stones and large chunks of concrete along the Black Creek streambanks; however, this material is beginning to erode away and not provide the desired level of protection. A vegetated and/or hard armor streambank erosion protection technique is recommended. Sheet 1 in Appendix D details the locations of the proposed improvements.

Farther upstream, near Route 1, is the only other area of significant streambank erosion that was identified in this stretch of Black Creek. This site is on the John Surfus property and is identified in Picture 12 (Appendix B) and location 12 on the Photo Log Location Map – Lower Black Creek – Sheet 1 (Appendix B). If funds are available, this section of stream (approximately 150 feet of the north bank) should be stabilized through vegetative and hard armoring techniques. Sheet 1 in Appendix D details the locations of the proposed improvements.

**Black Creek – Route 1 to CR 550E**

Black Creek meanders through this large floodplain forest. A majority of the stream is on property owned by Cold Springs Inc. All or almost all of this property relatively close to Black Creek is in the floodplain forest or is in set-aside acreage in the Conservation Reserve Program (CRP); therefore, the erosion and sediment coming from Cold Springs Inc. property is minimal. However, along Black Creek there are some major streambank bluffs. Some of these areas were historically hard armored by the early farmers. When cleaning the fields, the farmers would place the boulders along the stream bank. This practice is evident in a number of locations in this stretch of the stream and it has done a good job of protecting the streambanks in these locations.

Areas to consider for streambank erosion control include those shown in Pictures 14, 15, 18, 22, and 23 (Appendix B). These areas are either located along steep stream bluffs or they are located where the stream does 90 degree or “hairpin” turns. These three discrete locations are located in sections of Black Creek owned by Cold Springs Inc. A small section of Black Creek (Picture 20) shows some erosion along the stream bluff; however, the property owner (Richard Friend) asks that nothing be performed on his property. Sheet 2 in Appendix D details the locations of improvements proposed above.

As one progresses along this stretch of stream, agricultural row crop fields owned by Charles Howard are located close to Black Creek (Appendix A, Sheets 3 through 6). Given the fields’ proximity to Black Creek, a grass buffer strip is recommended for large portions of this property where it borders Black Creek. Sheet 2 in Appendix D details the locations where this option should be considered. It is recommended that the local NRCS office work with this landowner to determine whether this would be an acceptable conservation practice.

**Black Creek – CR 550E and the rest of the watershed**

After passing east of CR 550E, the Black Creek watershed predominantly discharges through agricultural row crop fields, pastures, and CRP set-aside acreage. Instead of densely vegetated

forested floodplains, the area around Black Creek and its tributaries is typically small forested and/or grass buffer strips or no buffer strips at all. Large tracts of forested floodplain are rare. Appendix C provides many pictures of these locations through out the remainder of the watershed.

Most of these sections of the watershed are ditches maintained by the county surveyor. In general, the vast majority of these ditches have stable streambanks and large areas of erosion are not evident. Also, many of these areas have either natural buffers (trees, pastures, or lawns) or Natural Resource Conservation Service support practices (buffer strips and CRP set-aside lands). Therefore, areas of mass erosion and erosion potential are not evident. However, given the fair amount of agricultural activities in these upper reaches of the Black Creek watershed, one can expect some degree of erosion and sediment discharge from these agricultural fields. This is evident in some of the upper levels of Black Creek and its tributaries in that sediment is prevalent in the streambed and in many places covers the stream substrate (rocks, stones, and pebbles). However, large areas of gully and rill erosion were not noted in the watershed.

Measures to reduce erosion from the agricultural fields are already being implemented to a great extent. These practices such as buffer strips, CRP set-aside, and no-till or minimal till practices should continue to be promoted on a watershed basis by the local NRCS. Although there are a number of locations in the watershed where these practices could be implemented, in particular in the upper sections of the watershed), we have noted a few closer to Hamilton Lake that should be of priority. Sheets 2 and 3 in Appendix D details the locations where, in our opinion, efforts should be concentrated.

**Summary and Recommendations**

The above sections present our observations of the watershed and sediment loads from the watershed. Specific locations to enhance water quality have been presented above. The remainder of this study will concentrate on making specific recommendations for the areas proposed for improvement identified above.

Sediment deposition at the Black Creek discharge into Hamilton Lake is evident and is documented by many of the local residents. This deposition causes the following problems and impairments:

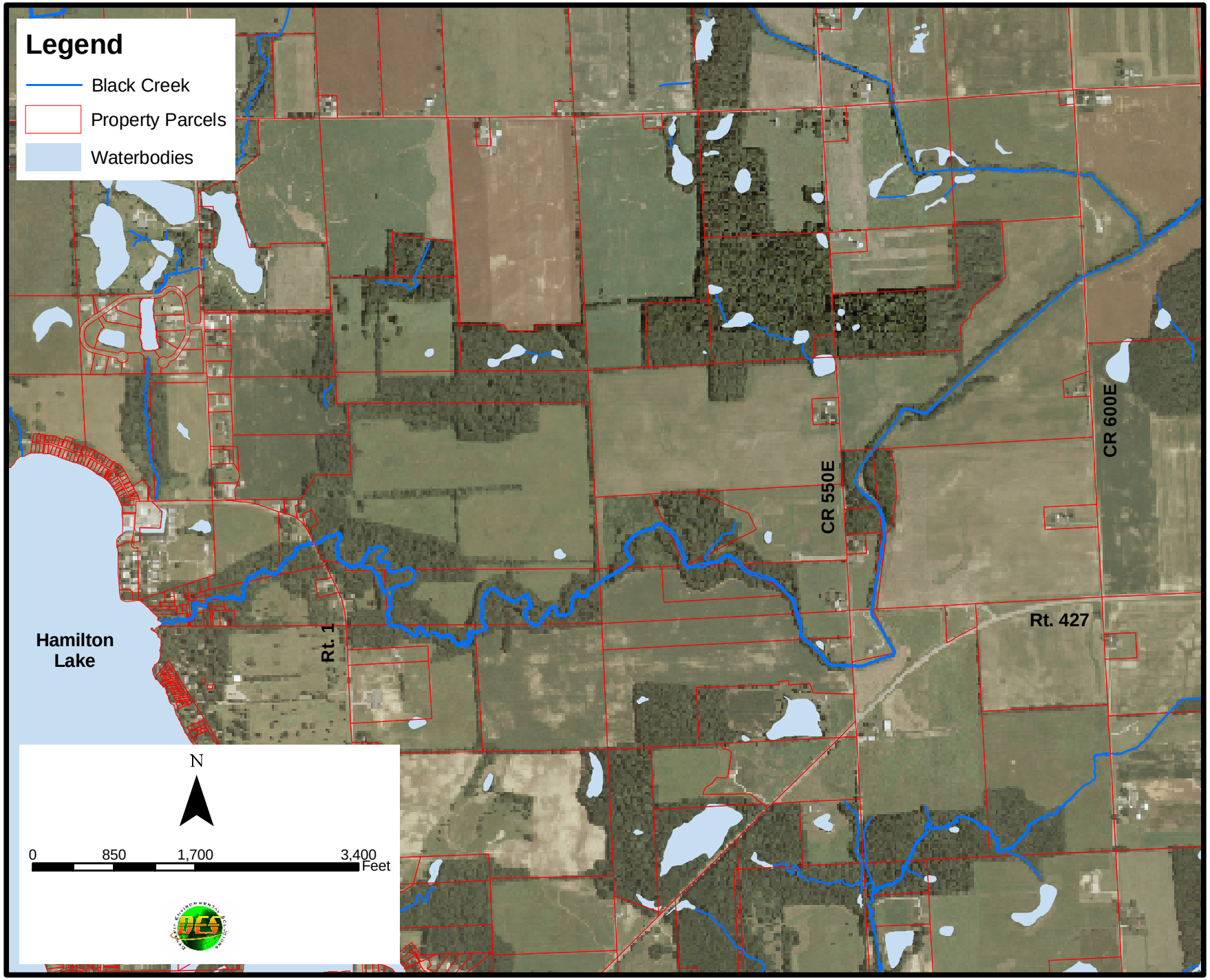
1. Local residents can not access the lake without extending their docks
2. During many months of the year, fish and other aquatic species can not access Black Creek as they historically could
3. Sediment plumes in this area lead to an aesthetically unpleasing environment

In this Memorandum, we have identified measures, which will reduce new sediment loads to the lake. However, none of these measures will address the sediment that has built up at the discharge of Black Creek into Hamilton Lake. Given property owner interest and the interest of the Hamilton Lake Association (HLA) in addressing this sediment build-up, we recommend that

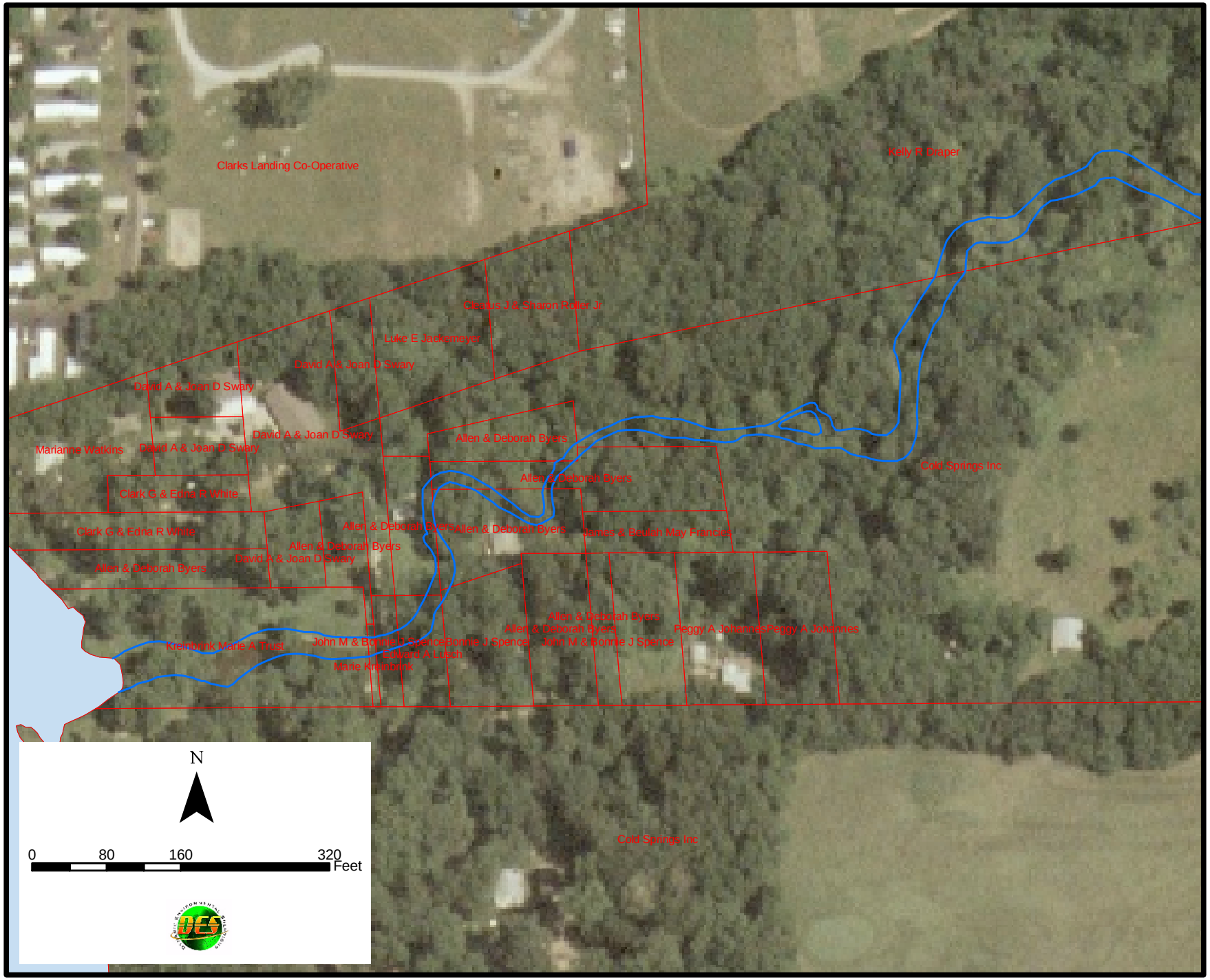
the HLA apply to the Indiana Department of Natural Resources Lake and River Enhancement (LARE) division for funding to perform a Sediment Management Plan or that the HLA utilize existing funding to prepare such a plan in accordance with LARE guidelines. This document is required before the HLA can apply for dredge funding from LARE to remove this sediment deposition.

# ATTACHMENT A

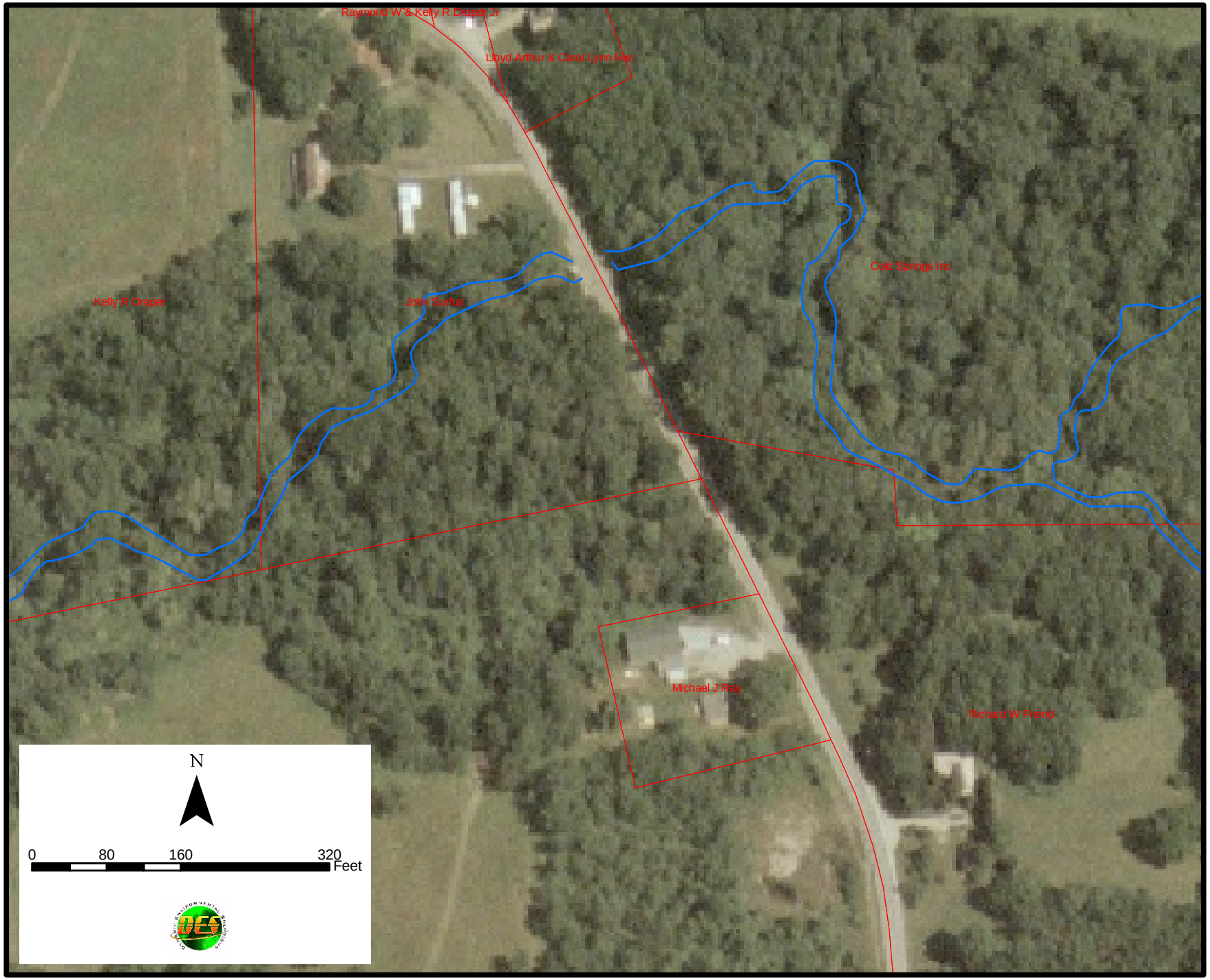
# Property Owner Map - Overview Map



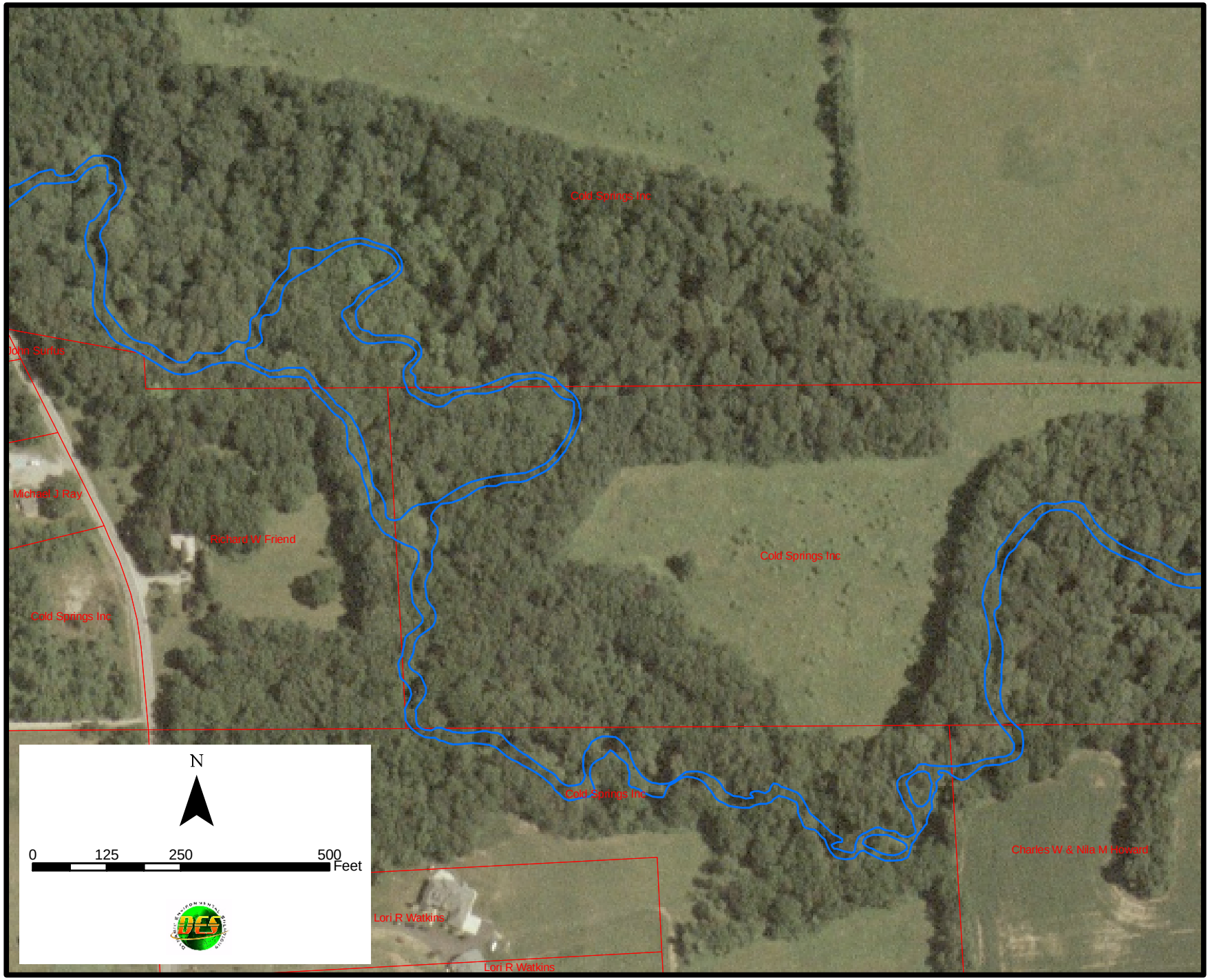
# Property Owner Map - Sheet 1



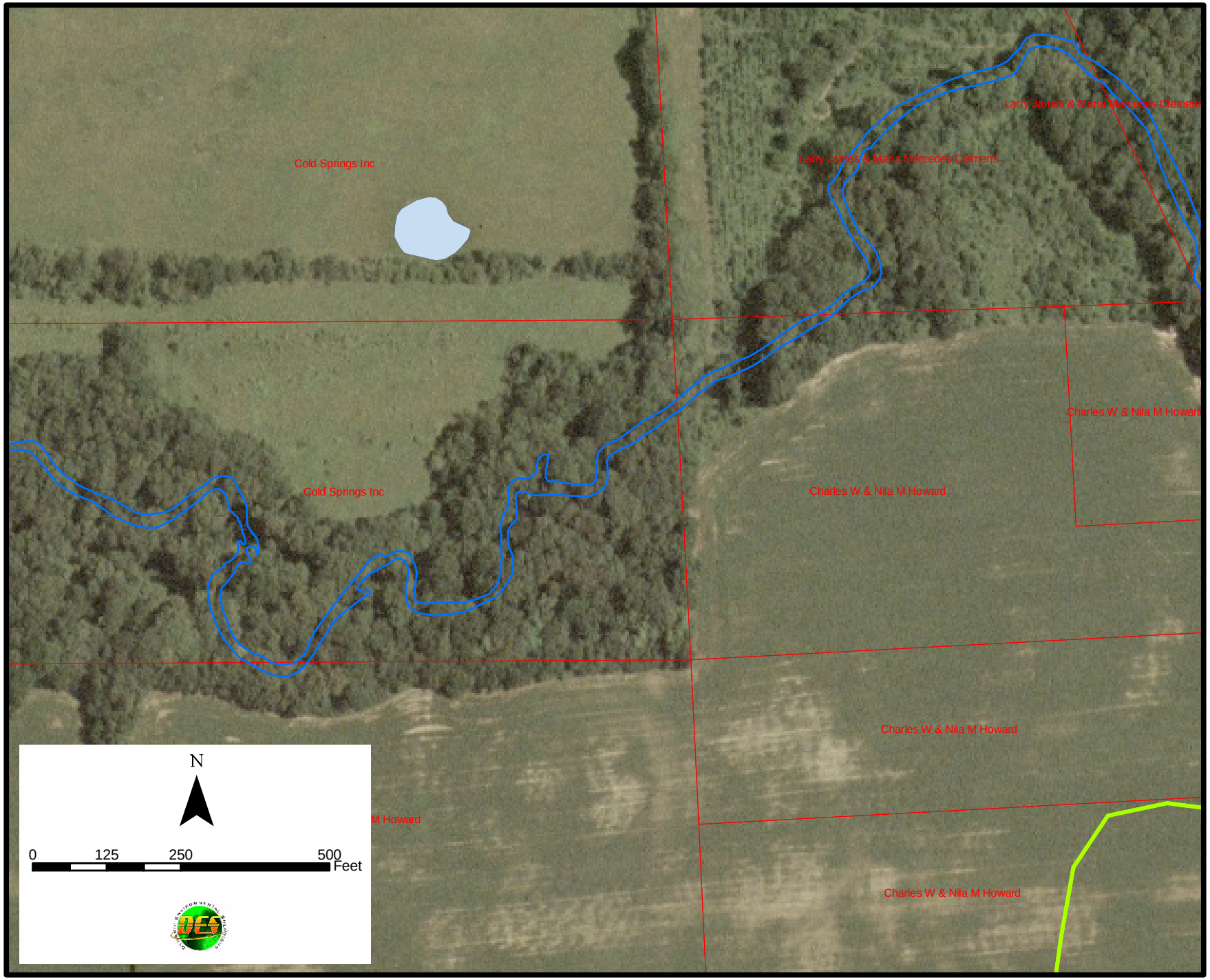
# Property Owner Map - Sheet 2



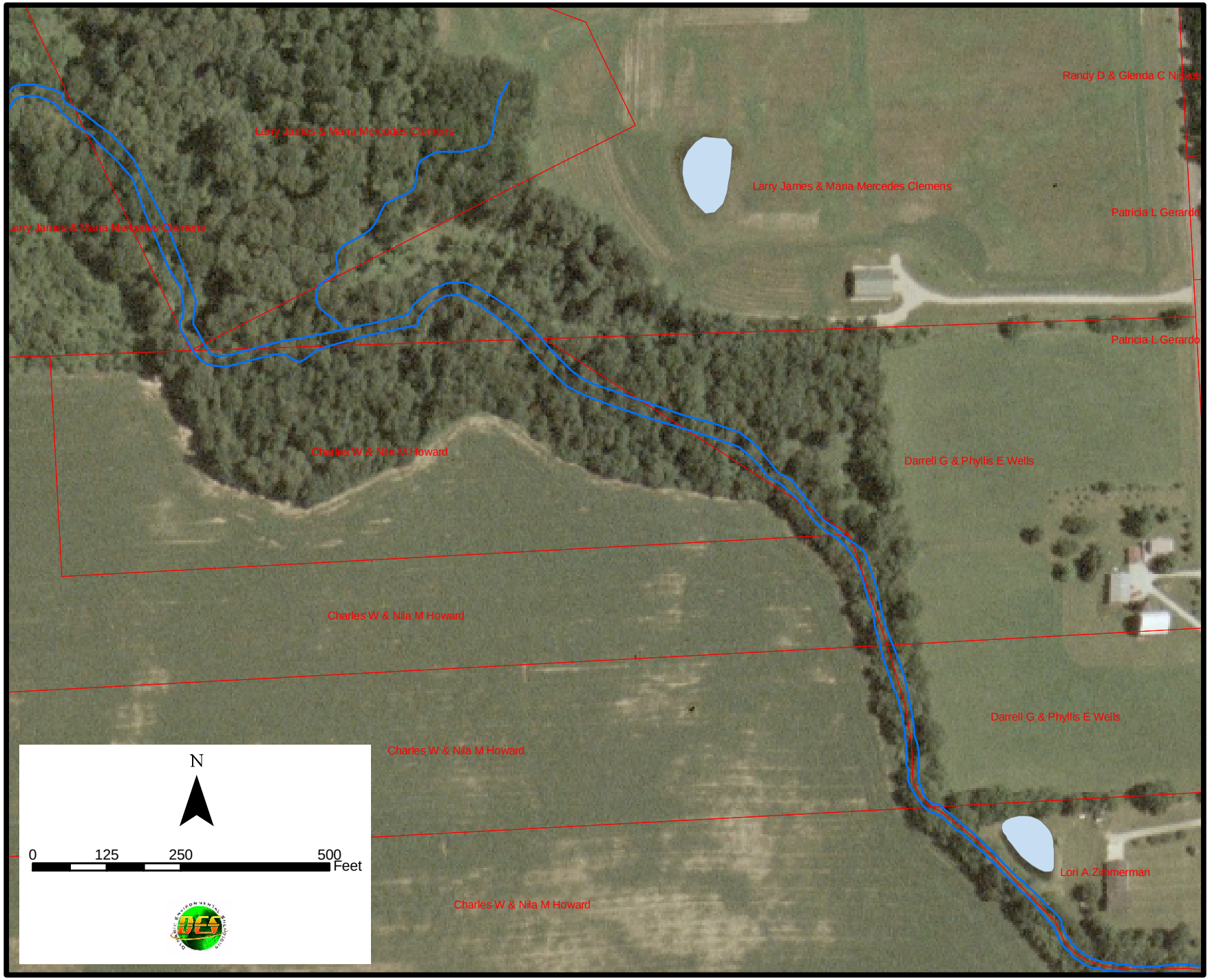
# Property Owner Map - Sheet 3



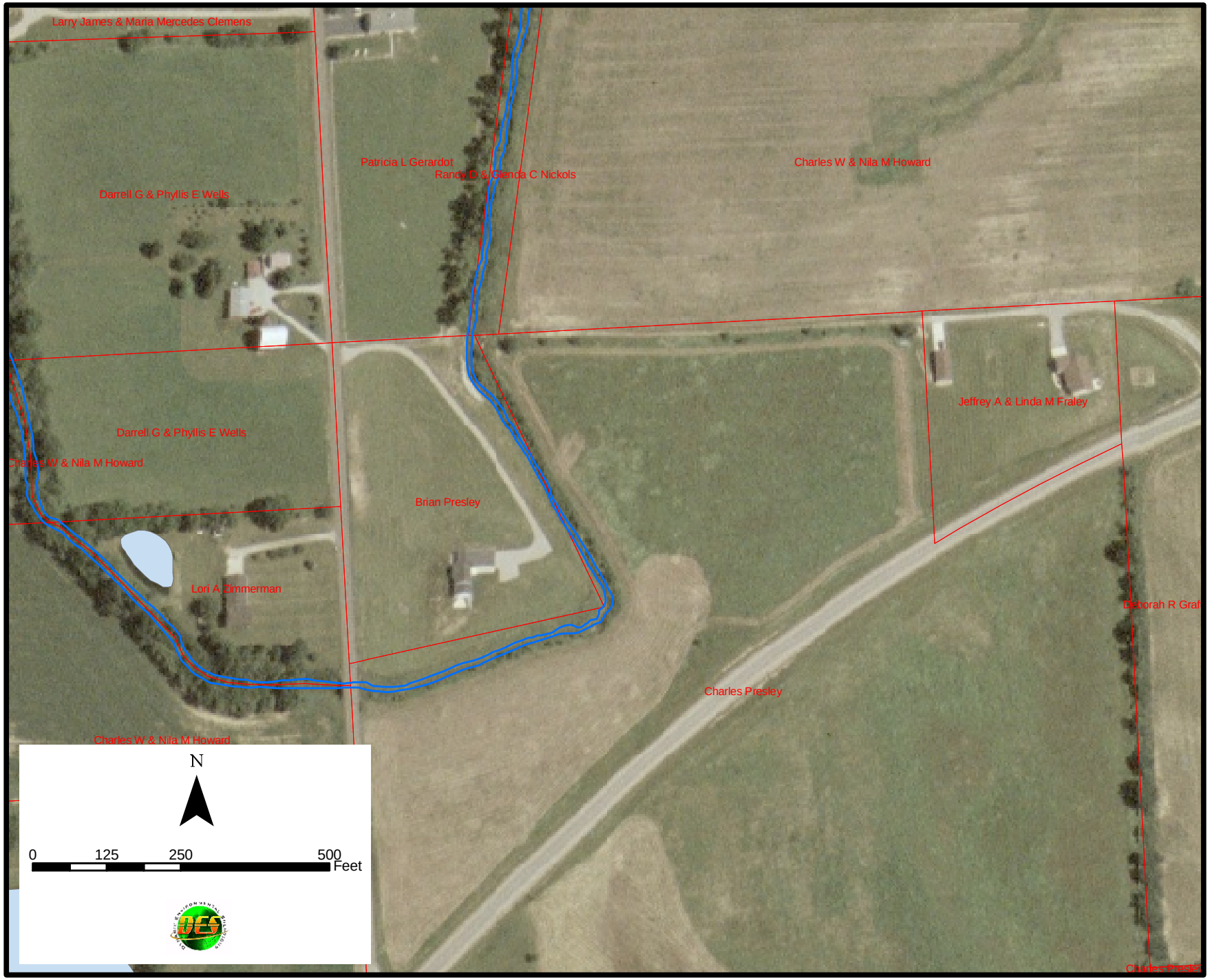
# Property Owner Map - Sheet 4



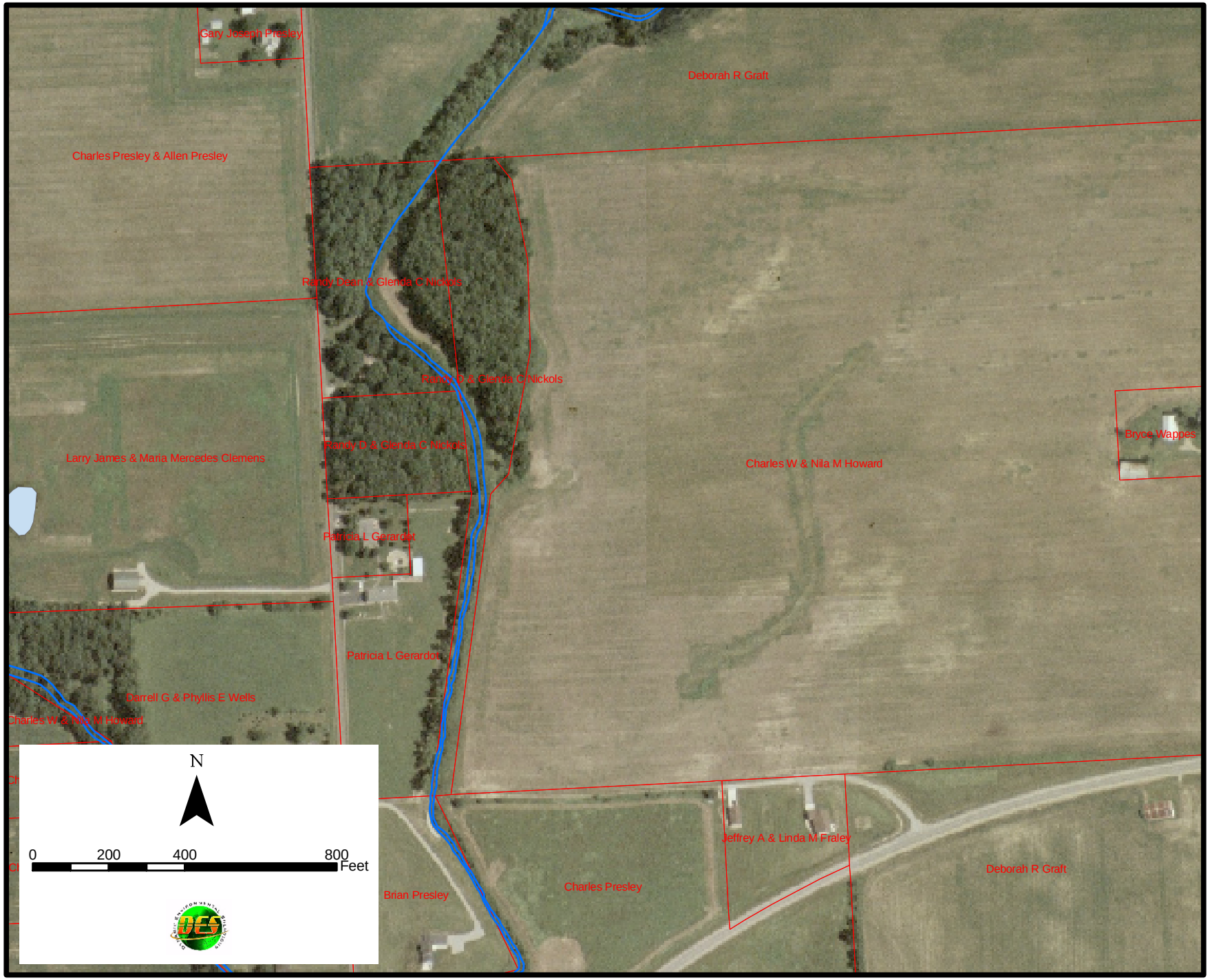
# Property Owner Map - Sheet 5



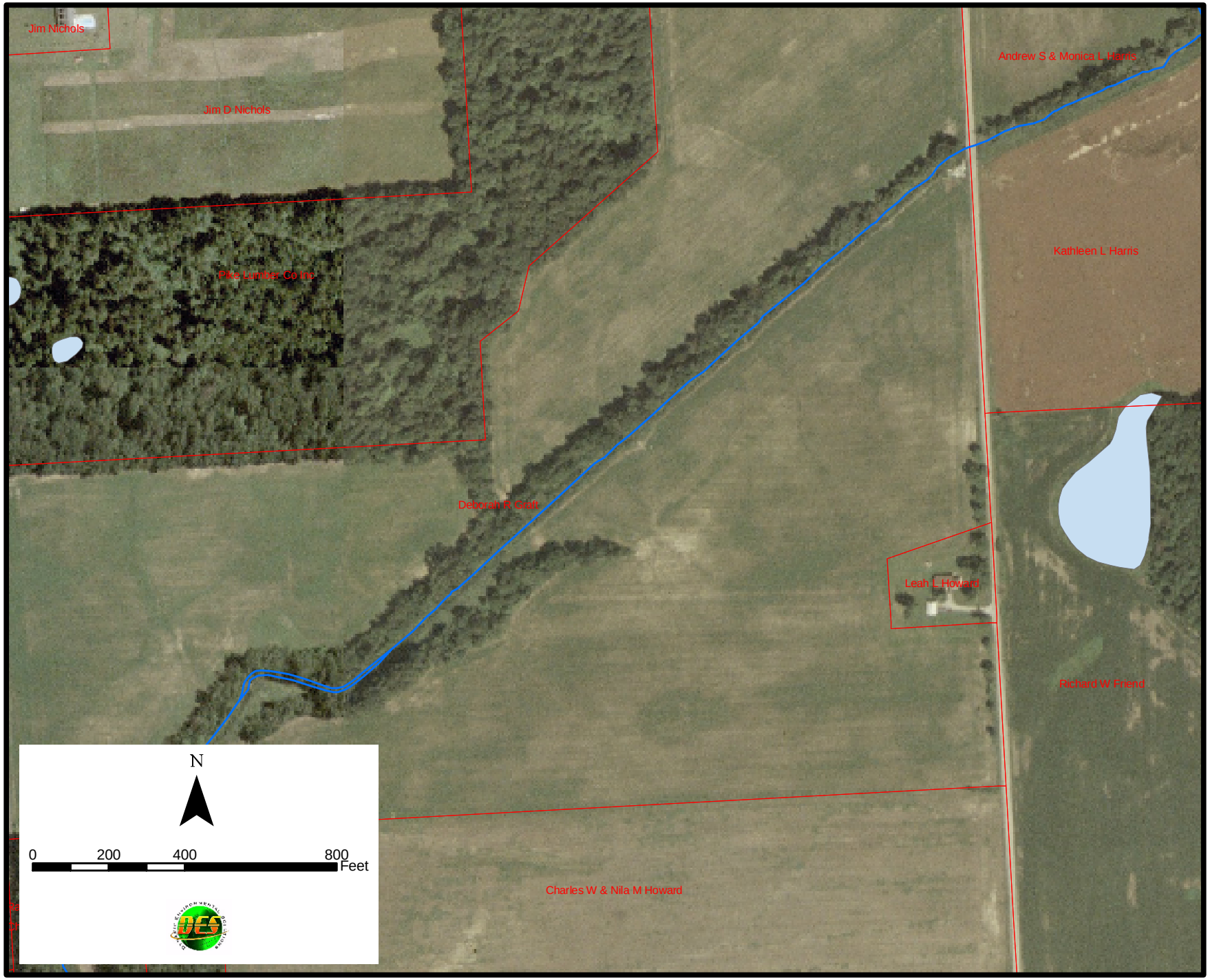
# Property Owner Map - Sheet 6



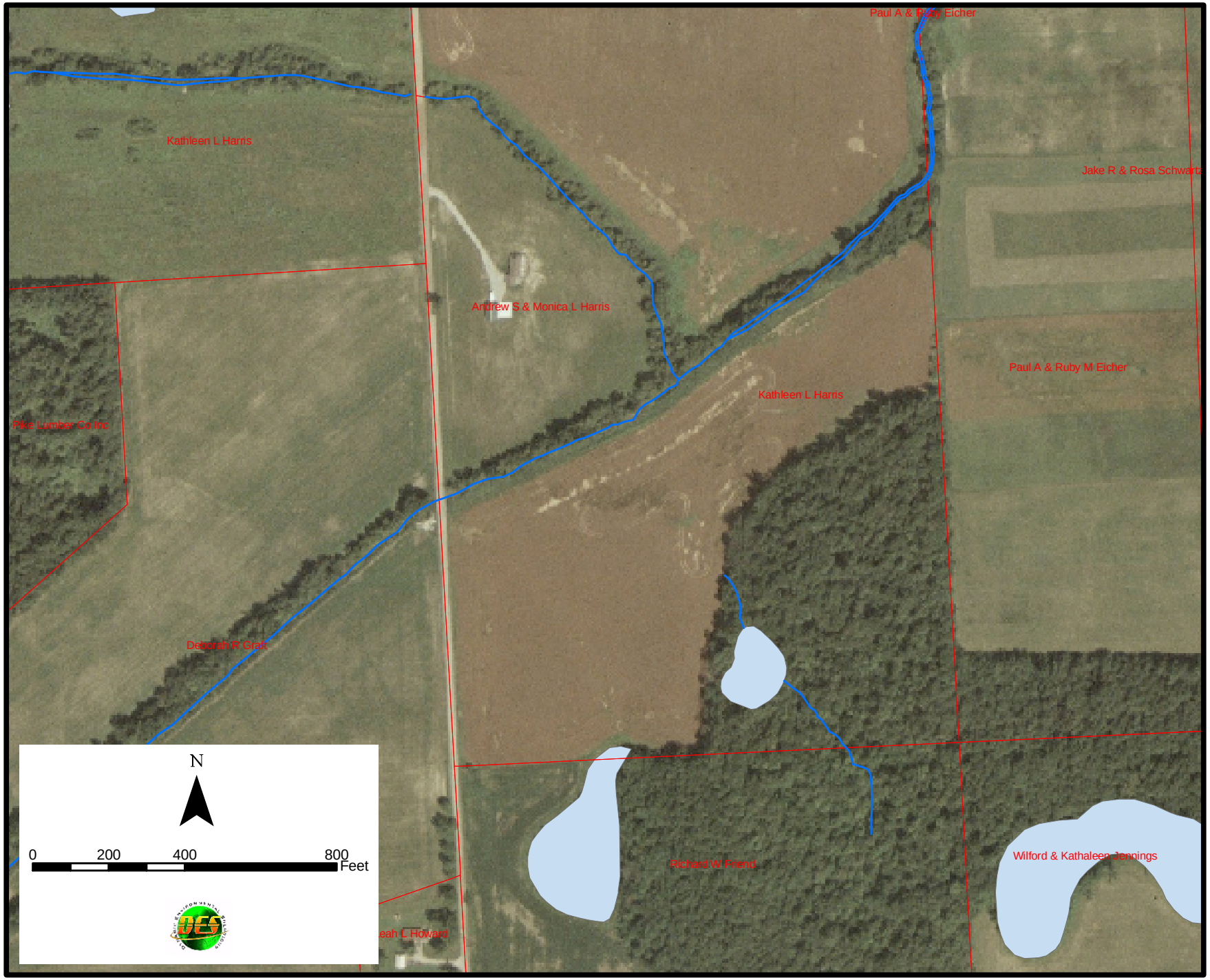
# Property Owner Map - Sheet 7



# Property Owner Map - Sheet 8

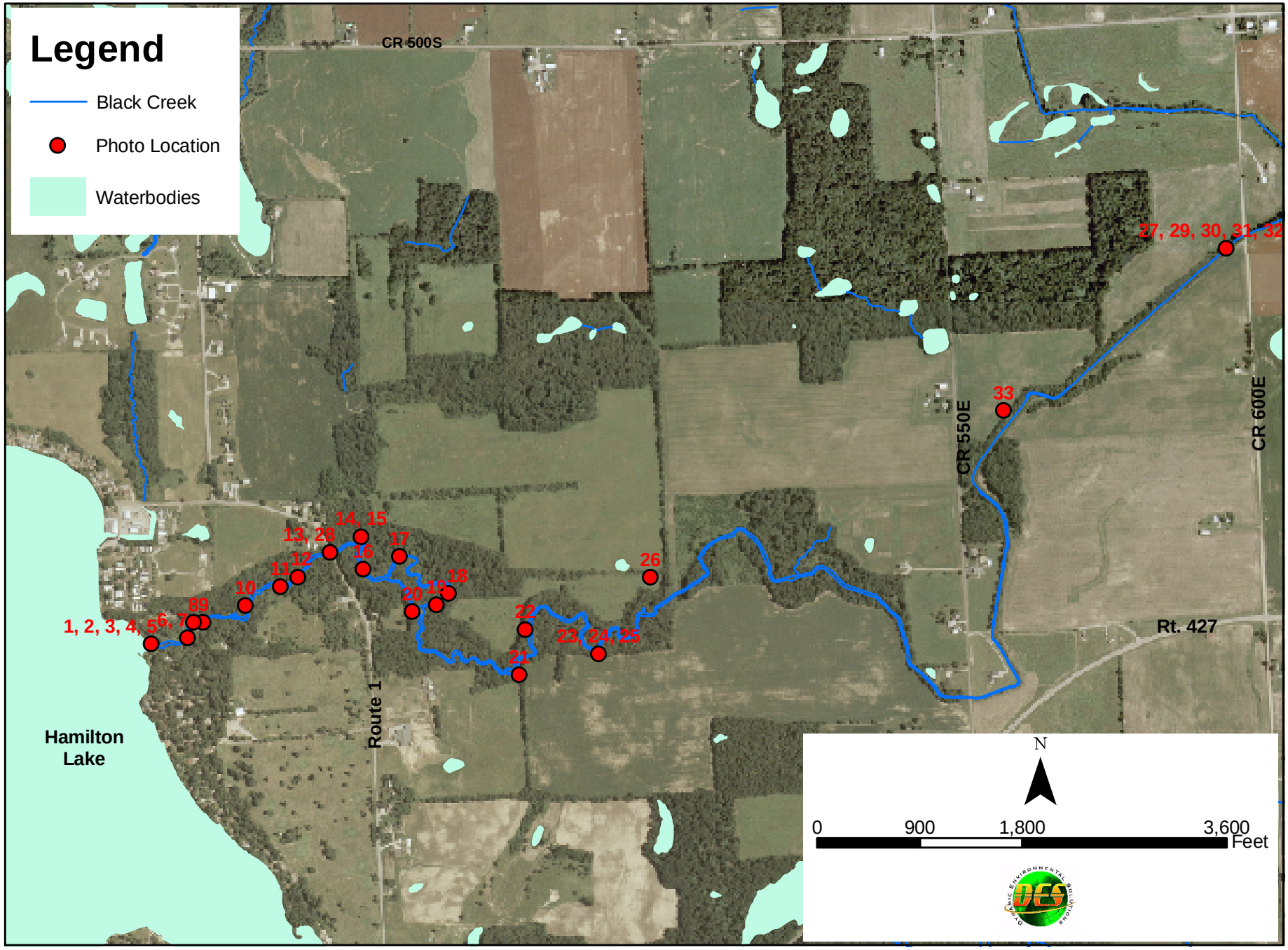


# Property Owner Map - Sheet 9

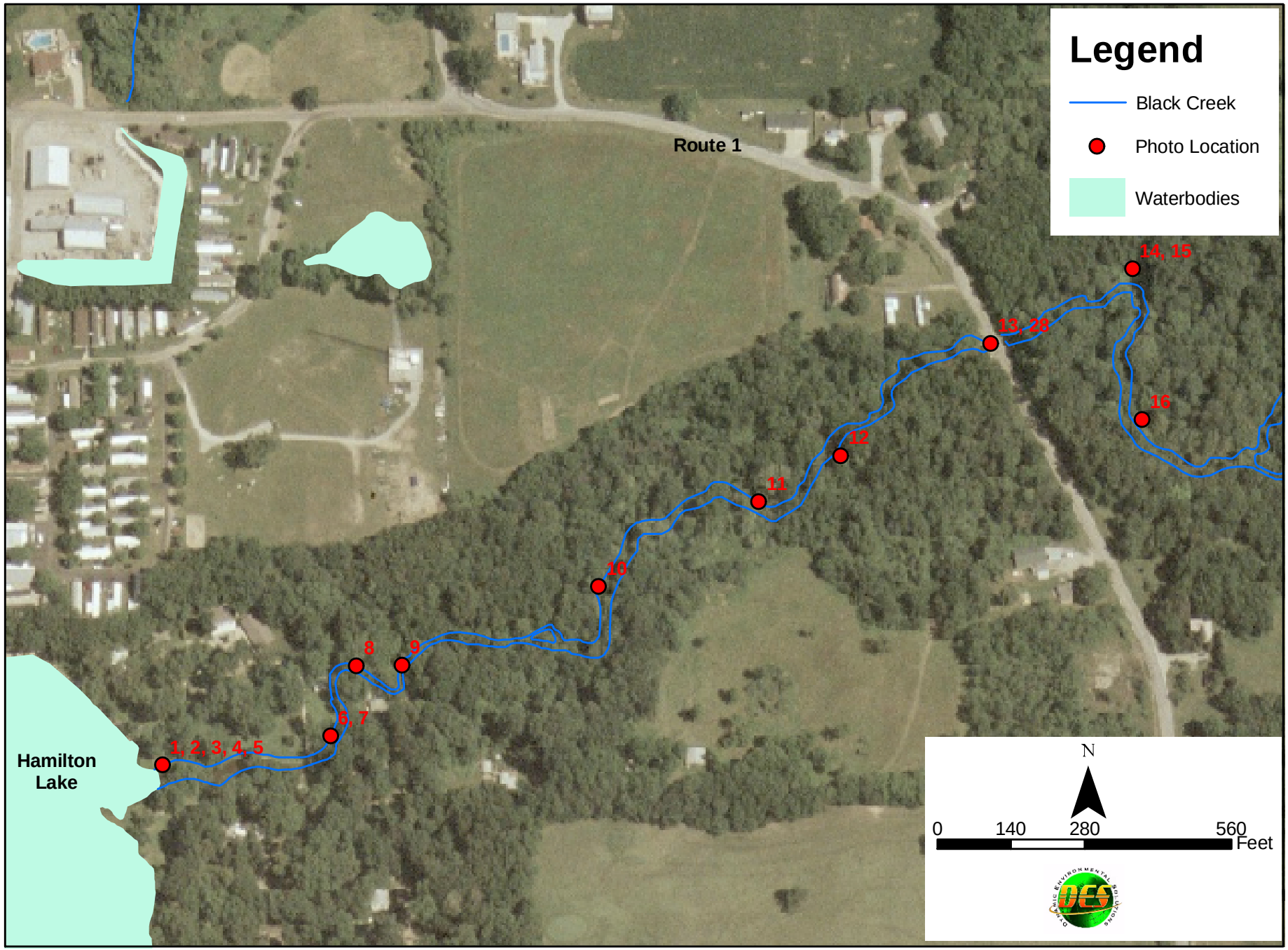


# ATTACHMENT B

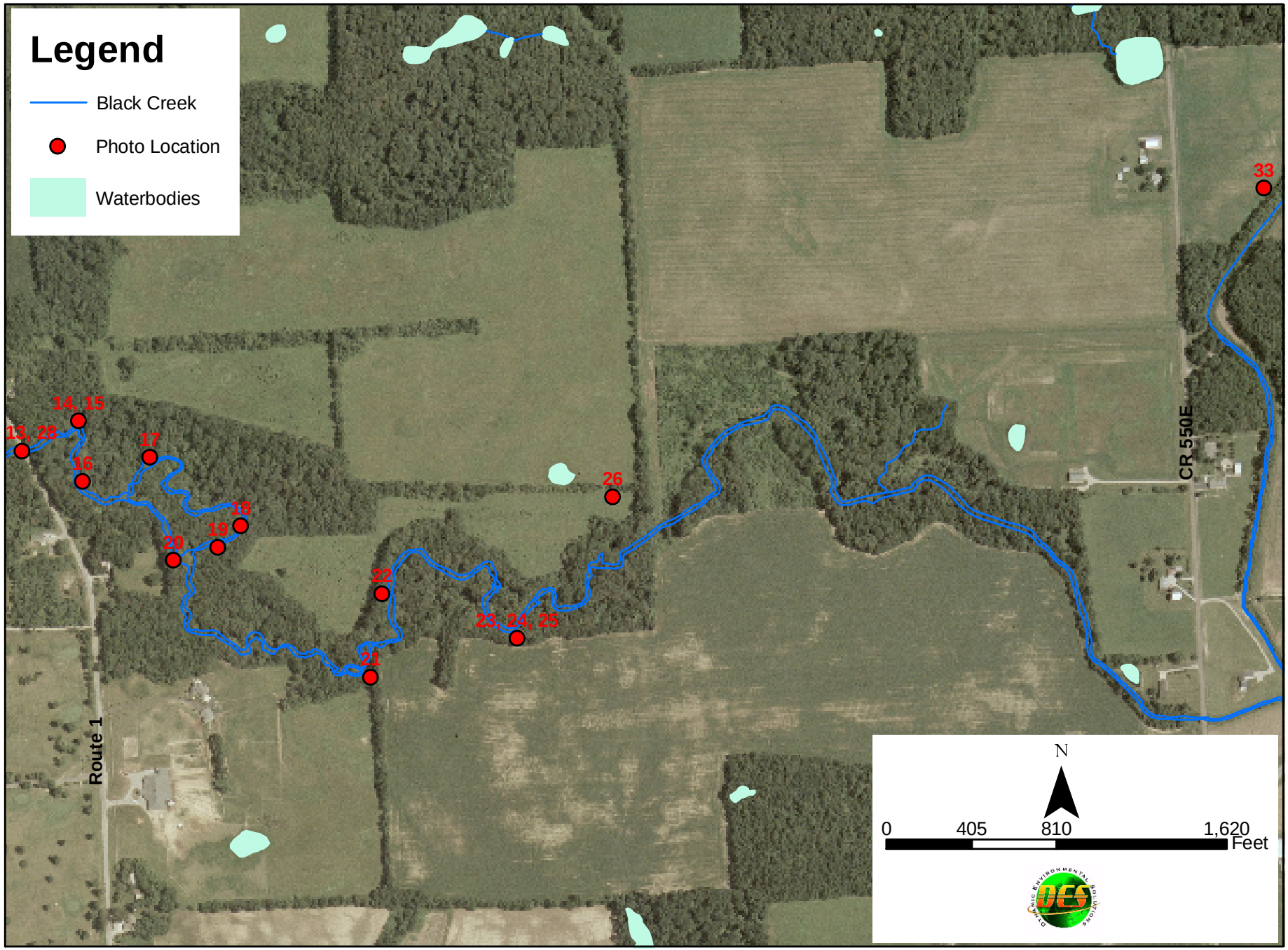
# Photo Log Location Map - Lower Black Creek - Overview Map



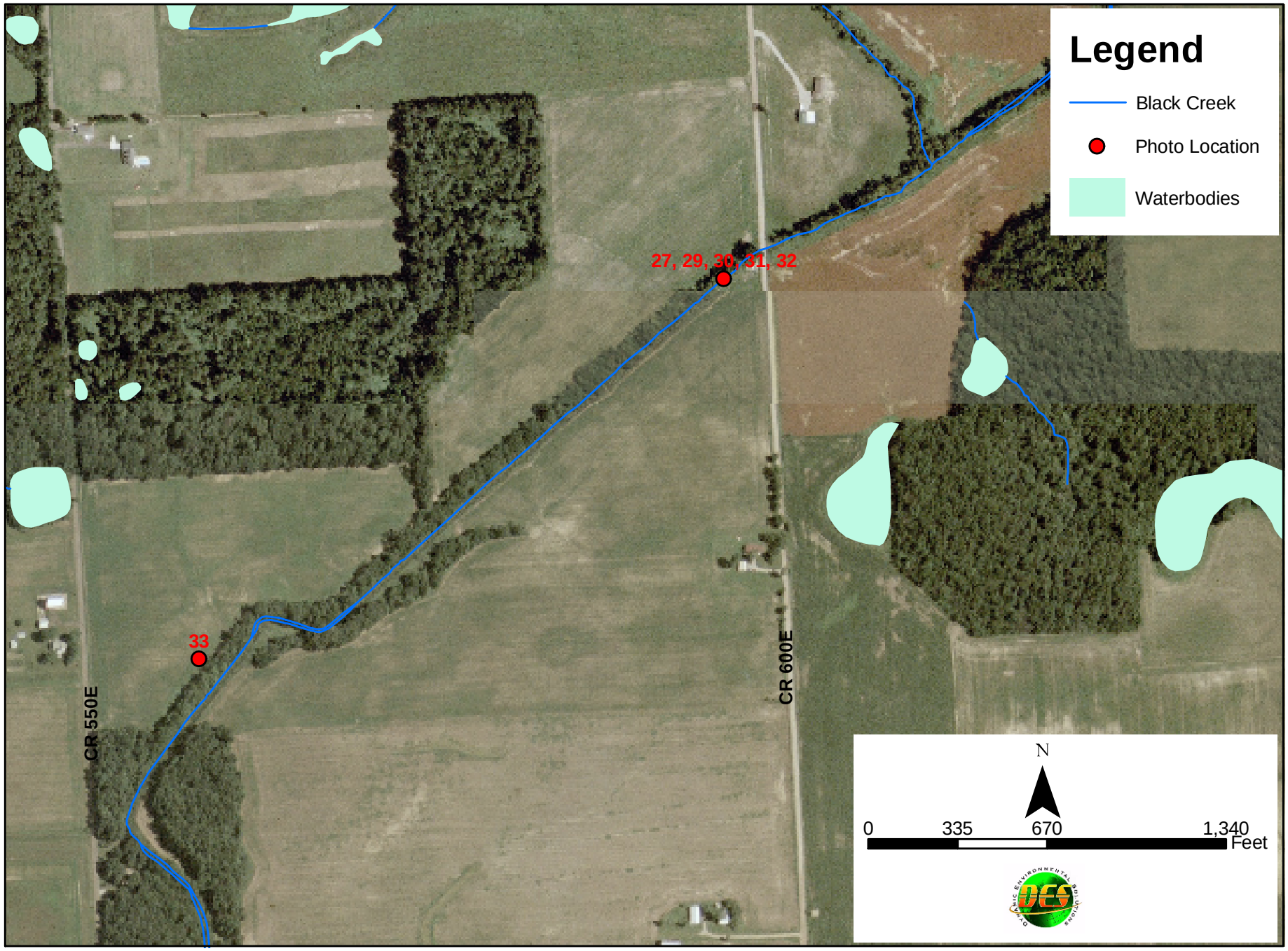
# Photo Log Location Map - Lower Black Creek - Sheet 1



# Photo Log Location Map - Lower Black Creek - Sheet 2



# Photo Log Location Map - Lower Black Creek - Sheet 3



**Picture 1: Black Creek at Hamilton Lake (Picture taken Northwest)**

**Picture 2: Black Creek at Hamilton Lake (Picture taken West)**

**Picture 3: Black Creek at Hamilton Lake (Picture taken Southwest)**

**Picture 4: Black Creek at Hamilton Lake (Picture taken to East or upstream)**

**Picture 5: Shoreline erosion and very shallow water from sediment deposition**

**Picture 6: Black Creek makes a 90 degree turn on the Lusch property**

**Picture 7: Black Creek makes another 90 degree turn on the Byers property**

**Picture 8: Tree roots providing streambank erosion protection on the Byers property**

**Picture 9: Natural pools and riffles in Black Creek on the Byers property**

**Picture 10: Coarse substrate and pools and riffles along this natural section of Black Creek**

**Picture 11: Evidence of some coarse sediment deposition**

**Picture 12: Small stretch of streambank erosion**

**Picture 13: Looking downstream from the bridge on Route 1**

**Picture 14: Erosion on "hairpin" bend on the Cold Springs Inc property (upstream view)**

**Picture 15: Downstream view of Picture 14**

**Picture 16: Natural pool and riffle area on the Cold Springs Inc property**

**Picture 17: Tree roots providing erosion protection**

**Picture 18: Erosion along the "hairpin" bend on the Cold Springs Inc property oxbow**

**Picture 19: Steep banks along the oxbow**

**Picture 20: Steep and eroding banks on the Friend property**

**Picture 21: Tree roots stabilizing banks on Cold Springs Inc property**

**Picture 22: Steep bluffs on 90 degree bend on Cold Springs Inc property**

**Picture 23: Slight bluff erosion on Cold Springs Inc property**

**Picture 24: Howard property fields outside of the Black Creek floodplain**

**Picture 25: Drainage from Howard fields down bluff into Black Creek**

**Picture 26: Typical buffer on Cold Springs Inc. property outside of the forested floodplain**

**Picture 27: Graft property next to Black Creek**

**Picture 28: Typical water quality photo of Black Creek upstream of Route 1**

**Picture 29: Field drainage of Graft property into Black Creek**

**Picture 30: Same as Picture 29**

**Picture 31: Black Creek segment through the Graft property**

**Picture 32: Same as Picture 31**

**Picture 33: Field drainage through berm and standpipe into Black Creek on Graft property**

# ATTACHMENT C

# Watershed Photo Log Location Map

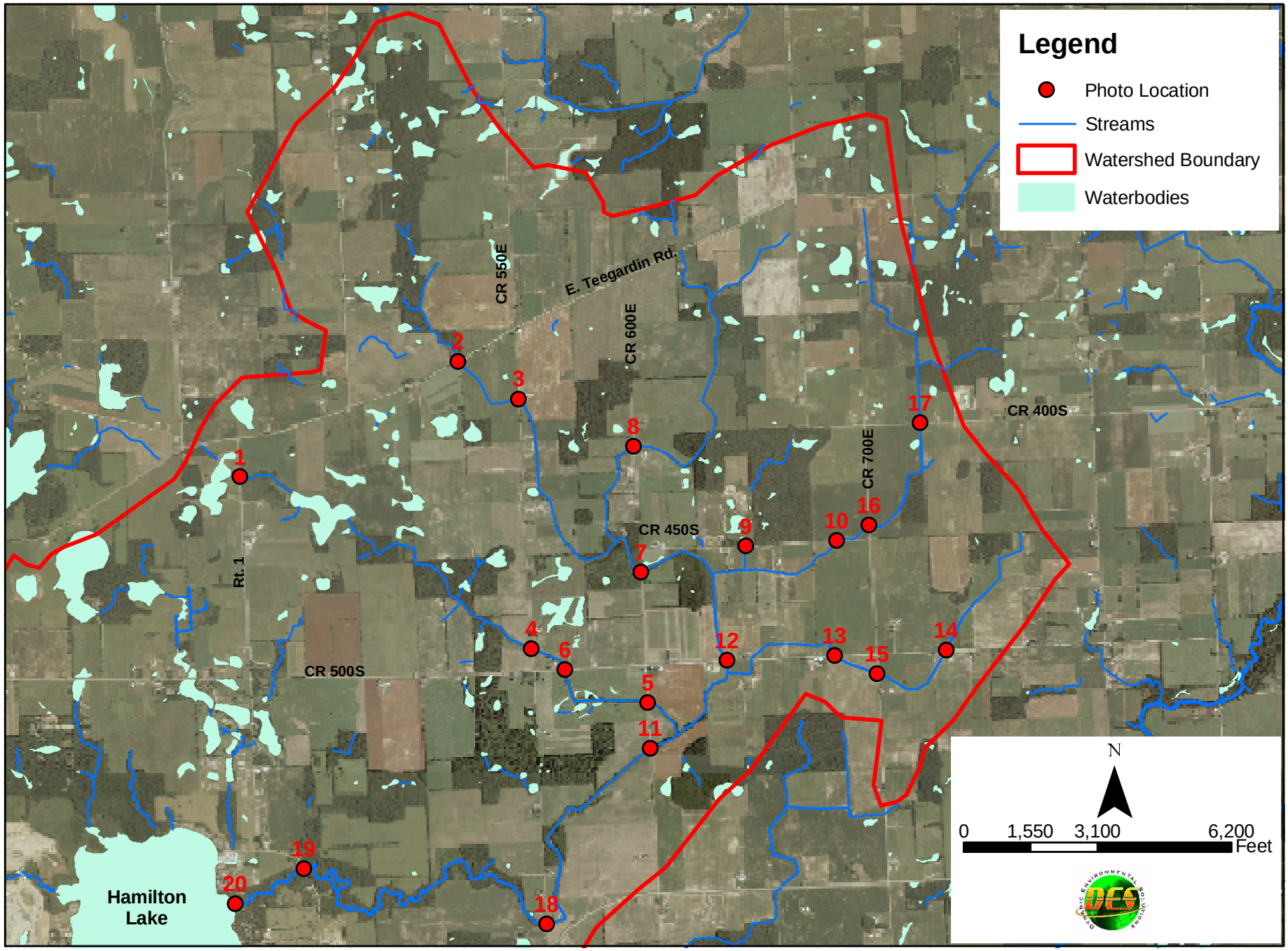


**Photo Location Map Guide**

| Location | Description | Picture # |
|---|---|---|
| 1 | Haughey Ditch at Route 1 | 1, 2 |
| 2 | Metz Ditch at E. Teegardin Road | 3, 4 |
| 3 | Metz Ditch at CR 550E | 5, 6 |
| 4 | Haughey Ditch at CR 550E | 7, 8 |
| 5 | Haughey Ditch at CR 600E | 9, 10 |
| 6 | Haughey Ditch at CR 500S | 11, 12 |
| 7 | Metz Ditch at CR 600E | 13, 14 |
| 8 | Burch Ditch at CR 600E | 15, 16 |
| 9 | Unnamed Branch of Black Creek at CR 450S | 17, 18 |
| 10 | Black Creek at CR 450S | 19, 20 |
| 11 | Black Creek at CR 600E | 21, 22 |
| 12 | Black Creek at CR 500S | 23, 24 |
| 13 | Unnamed Branch of Black Creek at CR 500S | 25, 26 |
| 14 | Unnamed Branch of Black Creek at CR 500S | 29, 30 |
| 15 | Unnamed Branch of Black Creek at CR 700E | 27, 28 |
| 16 | Black Creek at CR 700E | 31, 32 |
| 17 | Black Creek at CR 400S | 33, 34 |
| 18 | Black Creek at CR 550E | 35, 36 |
| 19 | Black Creek at Route 1 | 37, 38 |
| 20 | Black Creek at Hamilton Lake | 39, 40 |

**PHOTO LOG**

**Picture 1: Haughey Ditch at Route 1 (upstream)**

**Picture 2: Haughey Ditch at Route 1 (Downstream)**

**Picture 3: Metz Ditch at E. Teegardin Road (upstream)**

**Picture 4: Metz Ditch at E Teegardin Road (downstream)**

**Picture 5: Metz Ditch at CR 550E (upstream)**

**Picture 6: Metz Ditch at CR 550E (downstream)**

**Picture 7: Haughey Ditch at CR 550E (upstream)**

**Picture 8: Haughey Ditch at CR 550E (downstream)**

**Picture 9: Haughey Ditch at CR 600E (upstream)**

**Picture 10: Haughey Ditch at CR 600E (downstream)**

**Picture 11: Haughey Ditch at CR 500S (upstream)**

**Picture 12: Haughey Ditch at CR 500S (downstream)**

**Picture 13: Metz Ditch at CR 600E (upstream)**

**Picture 14: Metz Ditch at CR 600E (downstream)**

**Picture 15: Burch Ditch at CR 600E (upstream)**

**Picture 16: Burch Ditch at CR 600E (downstream)**

**Picture 17: Unnamed Branch of Black Creek at CR 450S (upstream)**

**Picture 18: Unnamed Branch of Black Creek at CR 450S (downstream)**

**Picture 19: Black Creek at CR 450S (upstream)**

**Picture 20: Black Creek at CR 450S (downstream)**

**Picture 21: Black Creek at CR 600E (upstream)**

**Picture 22: Black Creek at CR 600E (downstream)**

**Picture 23: Black Creek at CR 500S (upstream)**

**Picture 24: Black Creek at CR 500S (downstream)**

**Picture 25: Unnamed Branch of Black Creek at CR 500S (upstream)**

**Picture 26: Unnamed Branch of Black Creek at CR 500S (downstream)**

**Picture 27: Unnamed Branch of Black Creek at CR 700E (upstream)**

**Picture 28: Unnamed Branch of Black Creek at CR 700E (downstream)**

**Picture 29: Unnamed Branch of Black Creek at CR 500S (upstream)**

**Picture 30: Unnamed Branch of Black Creek at CR 500S (downstream)**

**Picture 31: Black Creek at CR 700E (upstream)**

**Picture 32: Black Creek at CR 700E (downstream)**

**Picture 33: Black Creek at CR 400S (upstream)**

**Picture 34: Black Creek at CR 400S (downstream)**

**Picture 35: Black Creek at CR 550E (upstream)**

**Picture 36: Black Creek at CR 550E (downstream)**

**Picture 37: Black Creek at Route 1 (upstream)**

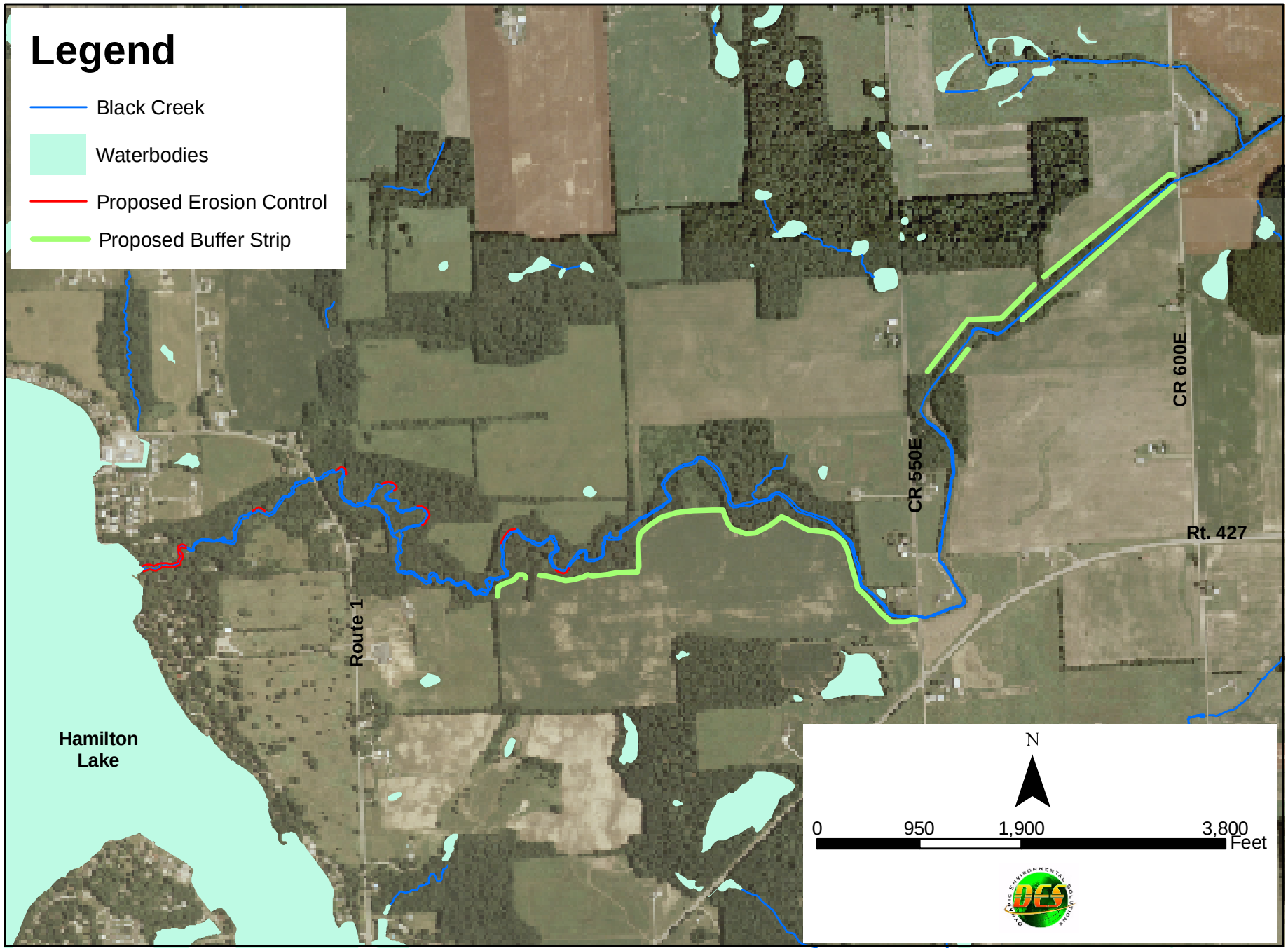
**Picture 38: Black Creek at Route 1 (downstream)**

**Picture 39: Black Creek at discharge into Hamilton Lake (upstream)**

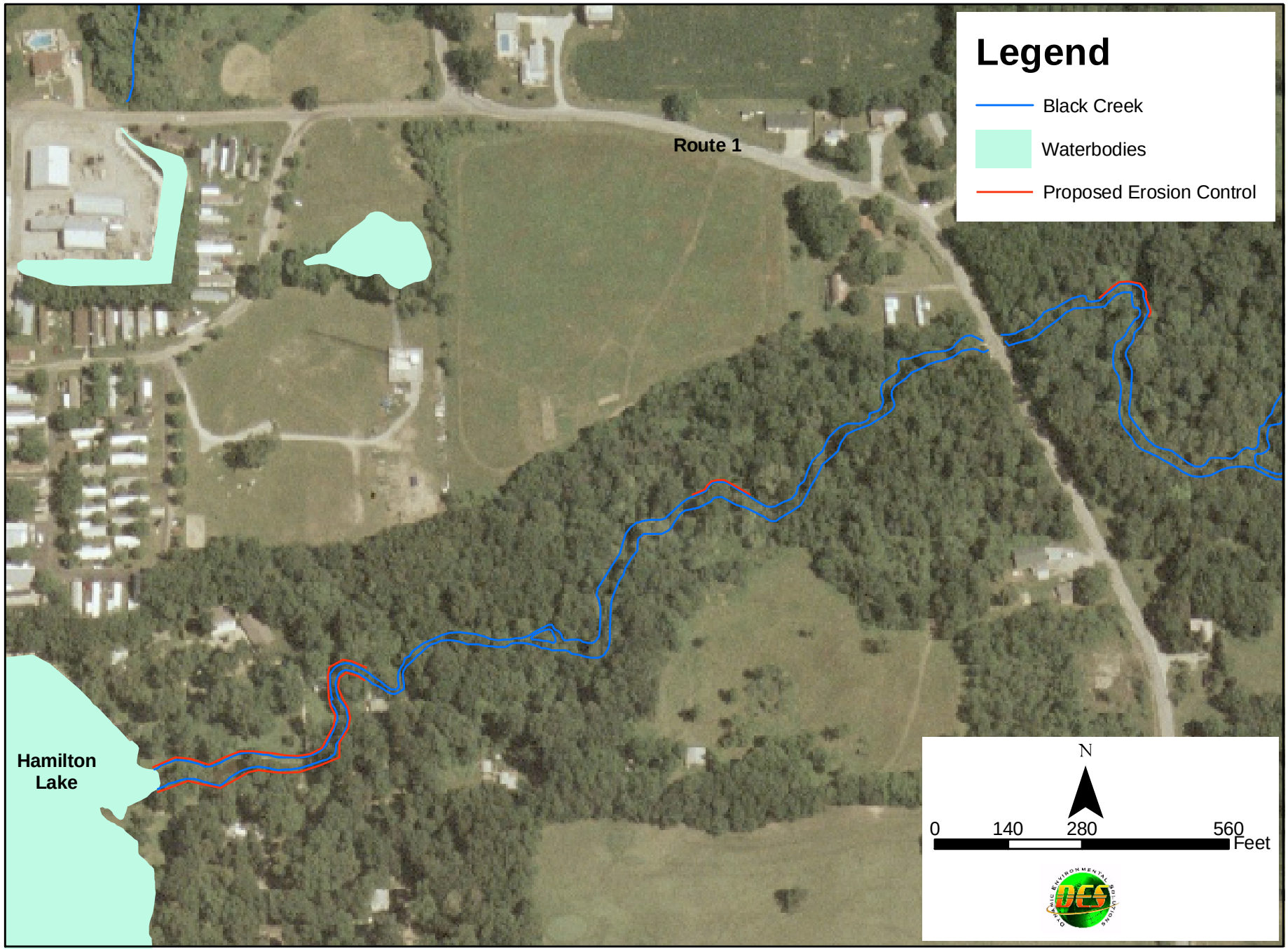
**Picture 40: Black Creek at discharge into Hamilton Lake (downstream)**

# ATTACHMENT D

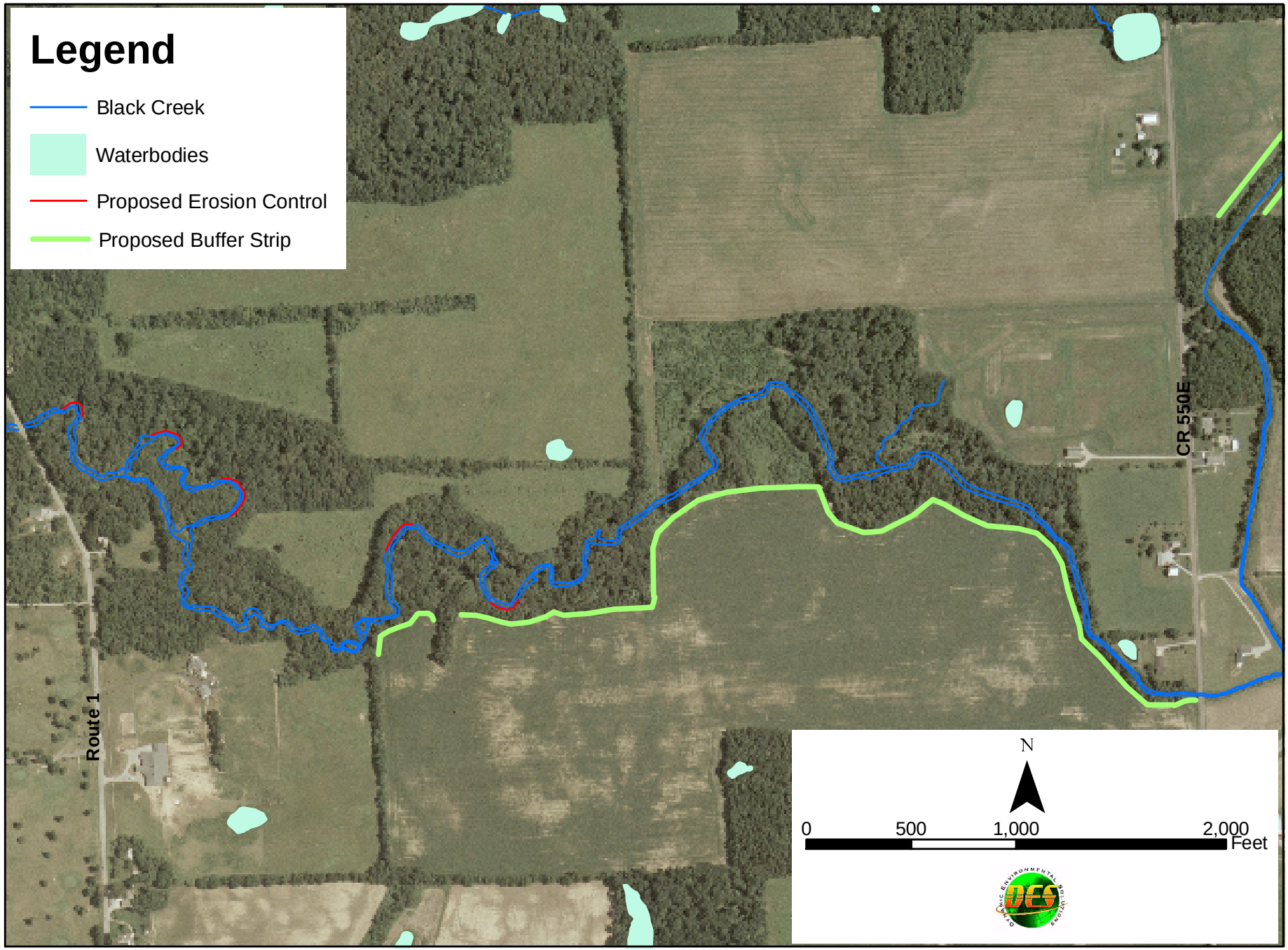
# Recommended Water Quality Enhancements - Overview Map



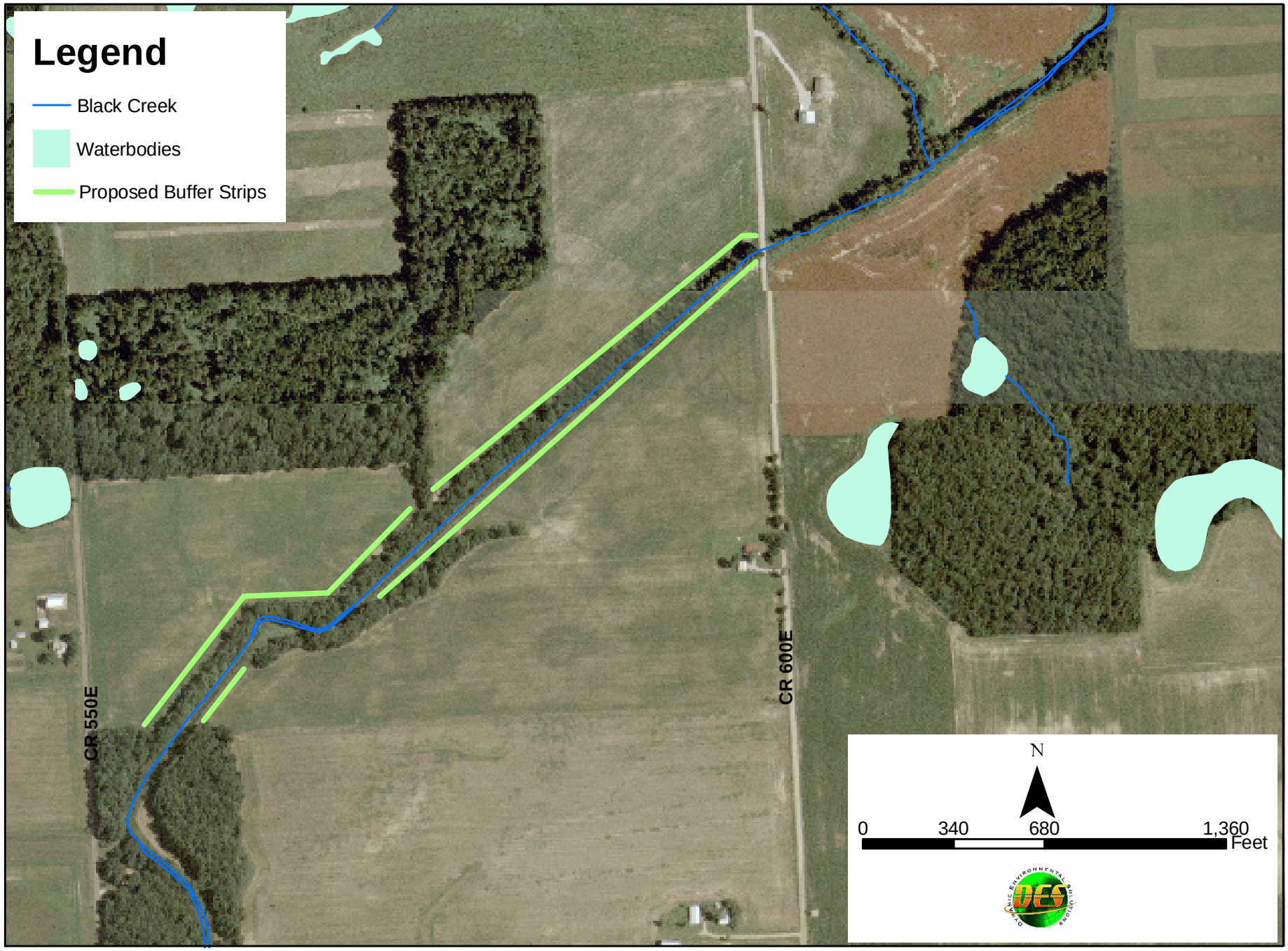
# Recommended Water Quality Enhancements - Sheet 1



# Recommended Water Quality Enhancements - Sheet 2



# Recommended Water Quality Enhancements - Sheet 3



# APPENDIX D

| Owner | Address | City | State | Zip |
|---|---|---|---|---|
| Streambank Enhancements | | | | |
| Marie Kreinbrink | 13468 Rd 8 | Ottawa | OH | 45875 |
| Allen & Deborah Byers | 95 Ln 110 B Hamilton Lk | Hamilton | IN | 46742 |
| John M & Bonnie J Spence | 4602 W Burton Dr | Muncie | IN | 47304 |
| Edward A Lusch | P O Box 291 | Hamilton | IN | 46742 |
| John Surfus | 285 Virginia Ave | Fort Myers Beach | FL | 33931 |
| Cold Springs Inc | 6068 St Rd 1 | Hamilton | IN | 46742 |
| | | | | |
| Buffer Strips | | | | |
| Charles W & Nila M Howard | 11630 Trade Wind Cove | Fort Wayne | IN | 46845 |
| Deborah Graft | 5525 E State Rd 427 | Hamilton | IN | 46742 |

# APPENDIX E

February 9, 2006

Ms. Elizabeth McCloskey
U.S. Fish & Wildlife Service
P.O. Box 2616
Chesterton, IN 46304-2616

Dear Ms. McCloskey:

Dynamic Environmental Solutions, Inc (DES) has been retained by the Hamilton Lake Association (HLA) to perform an Engineering Feasibility Study to determine ways to improve water quality that discharges from the Black Creek watershed into Hamilton Lake. DES successfully worked with HLA in obtaining this grant from the Indiana Department of Natural Resources (IDNR) Lake and River Enhancement (LARE) division. Hamilton Lake is located in Steuben County in Hamilton, Indiana.

The Black Creek watershed, as shown in the attached figure, encompasses approximately 5,600 acres of predominantly agricultural watershed. Water quality improvement options being considered for this study includes constructed wetlands, streambank stabilization, check dams, filter strips, grass swales and other water quality improvement Best Management Practices (BMPs). As early coordination for this project, which is expected to include the submission of specific construction permits to the State of Indiana and U.S. Corps of Engineers this fall, we ask for an environmental review of this watershed that would identify areas of potential concern including the following:

- Presence of threatened and endangered species
- Presence of historical or cultural sites
- Any other areas of potential concern to the U.S. Fish & Wildlife Service

If you have any questions, please call me at (630) 536-7607 or email me at dmulvey@des-group.co.uk. Thanks again for your time and assistance.

Very truly yours,
**Dynamic Environmental Solutions, Inc.**

Douglas L. Mulvey, P.E., MBA
Project Manager

Enclosure: As noted

Dynamic Environmental Solutions, Inc.
5 S 506 Bonnie Court, Naperville, IL, 60563
Tel: (630) 536-7607 • Fax: (630) 723-0798

February 8, 2006

Ms. Christie Kiefer, Environmental Coordinator
Indiana Department of Natural Resources
Division of Water, Environmental Unit
402 W. Washington St., W264
Indianapolis, IN 46204-2641

Dear Ms. Kiefer:

Dynamic Environmental Solutions, Inc (DES) has been retained by the Hamilton Lake Association (HLA) to perform an Engineering Feasibility Study to determine ways to improve water quality that discharges from the Black Creek watershed into Hamilton Lake. DES successfully worked with HLA in obtaining this grant from the Indiana Department of Natural Resources (IDNR) Lake and River Enhancement (LARE) division. Hamilton Lake is located in Steuben County in Hamilton, Indiana.

The Black Creek watershed, as shown in the attached figure, encompasses approximately 5,600 acres of predominantly agricultural watershed. Water quality improvement options being considered for this study includes constructed wetlands, streambank stabilization, check dams, filter strips, grass swales and other water quality improvement Best Management Practices (BMPs). As early coordination for this project, which is expected to include the submission of specific construction permits this fall, we ask for an environmental review of this watershed that would identify areas of potential concern including the following:

- Presence of threatened and endangered species
- Presence of historical or cultural sites
- Any other areas of potential concern to the Indiana Department of Natural Resources

If you have any questions, please call me at (630) 536-7607 or email me at dmulvey@des-group.co.uk. Thanks again for your time and assistance.

Very truly yours,
**Dynamic Environmental Solutions, Inc.**

Douglas L. Mulvey, P.E., MBA
Project Manager

Enclosure: As noted

Dynamic Environmental Solutions, Inc.
5 S 506 Bonnie Court, Naperville, IL, 60563
Tel: (630) 536-7607 • Fax: (630) 723-0798

Mitchell E. Daniels, Jr., Governor
Kyle J. Hupfer, Director

DNR Indiana Department of Natural Resources

Division of Historic Preservation & Archaeology • 402 W. Washington Street, W274 • Indianapolis, IN 46204-2739
Phone 317-232-1646 • Fax 317-232-0693 • dhpa@dnr.IN.gov

March 21, 2006

Douglas L. Mulvey
Dynamic Environmental Solutions, Inc.
5 S 506 Bonnie Court
Naperville, Illinois 60563

State Agency: Indiana Department of Natural Resources

Re: Information concerning an engineering feasibility study to determine ways to improve the water quality of discharges from Black Creek watershed into Hamilton Creek(DNR #12024)

Dear Mr. Mulvey:

Pursuant to Indiana Code 14-21-1 the Indiana Department of Natural Resources, Division of Historic Preservation and Archaeology ("DHPA") has conducted a review of the materials dated February 8, 2006, and received by the DHPA on February 17, 2006, for the above indicated project in the Black Creek watershed, Steuben County, Indiana.

In terms of potential impact upon archaeological resources, a review of our records indicates that the 5,600 acre project area is environmentally suitable to contain archaeological resources, but has never been evaluated by a qualified archaeologist. Moreover, there are likely to be dozens of previously unrecorded archaeological sites within the Black Creek watershed. If any of the proposed project activities entail ground disturbing activities, then an archaeological reconnaissance will most likely be required to determine the presence or absence of archaeological resources. This determination will be made specific to each individual construction permit submitted to our office. Also, please be advised that if any archaeological artifacts, features, or human remains are uncovered during construction, state law (Indiana Code 14-21-1-27 & 29) requires that the discovery must be reported to the Department of Natural Resources.

In regard to buildings and structures, please provide the indicated information to facilitate the identification and analysis of historic properties in the project area:

1) Identify the undertaking.[1]

2) Provide an overall description of the project and its location.

   - Include address, city, township, and county.
   - Detail any construction, demolition, and earthmoving activities.

3) Define the area of potential effects[2] and provide a map or a good quality photocopy of a map containing the following:

   - The boundaries of the area of potential effects and the precise location of the project area within those boundaries clearly outlined in dark ink on a copy of the relevant portion of a town, city, county, or U.S. Geological Survey quadrangle map.

---

[1] Undertaking means a project, activity, or program funded in whole or in part under the direct or indirect jurisdiction of a Federal agency, including those carried out by or on behalf of a Federal agency; those carried out with Federal financial assistance; those requiring a Federal permit, license or approval; and those subject to state or local regulation administered pursuant to a delegation or approval by a Federal agency (see 36 C.F.R. § 800.16[y]).

[2] Area of potential effects means the geographic area or areas within which an undertaking may directly or indirectly cause changes in the character or use of historic properties, if any such properties exist. The area of potential effects is influenced by the scale and nature of an undertaking and may be different for different kinds of effects caused by the undertaking (see 36 C.F.R § 800. 16[d]).

- The names of nearby landmarks clearly labeled (e.g., major streets, roads, highways, railroads, rivers, lakes).

4) Give the precise location of any buildings, structures, and objects *within the area of potential effects* (e.g., addresses and a site map with properties keyed to it).

5) Give the known or approximate date of construction for buildings, structures, objects, and districts *within the area of potential effects*.

6) Submit historical documentation for buildings, structures, objects, and districts *within the area of potential effects*.

7) List all sources checked for your historical research of the *area of potential effects*.

8) Provide recent, clear photographs or good quality computer-generated images (not photocopies), keyed to a site plan, showing the exterior of any buildings, structures, objects, or land *that could be affected in any way by the project.*

If you have any further questions regarding this determination, please contact our office at (317) 232-1646. Questions about archaeological issues should be directed to Christopher Koeppel or Dr. Rick Jones. Questions about historic buildings or structures pertaining to this project should be directed to Miriam Widenhofer.

Very truly yours,

Miriam L. Widenhofer
Structures Review Assistant

JCS:CDK:MLW:mlw

Enclosures (4)

cc: Christie Stanifer, Indiana Department of Natural Resources, Division of Water

# United States Department of the Interior
## Fish and Wildlife Service

Bloomington Field Office (ES)
620 South Walker Street
Bloomington, IN 47403-2121
Phone: (812) 334-4261 Fax: (812) 334-4273

March 30, 2006

Mr. Douglas L. Mulvey
Dynamic Environmental Solutions, Inc.
5 S 506 Bonnie Court
Naperville, Illinois 60563

Project: Black Creek Lake and River Enhancement Feasibility Study
Location: Black Creek Watershed of Hamilton Lake, Steuben County

Dear Mr. Mulvey:

This responds to your letter dated February 9, 2006, requesting our comments on the aforementioned project.

These comments have been prepared under the authority of the Fish and Wildlife Coordination Act (16 U.S.C. 661 et. seq.) and are consistent with the intent of the National Environmental Policy Act of 1969, the Endangered Species Act of 1973, and the U. S. Fish and Wildlife Service's Mitigation Policy.

The project consists of an investigation of the Black Creek Watershed to determine water quality improvement options related to streambank erosion, runoff from fields and residential sites, and similar issues. The watershed encompasses approximately 5,600 acres of primarily agricultural lands. These agricultural lands include active row-crop cropland, pasture, and fallow fields that likely are within the U.S. Department of Agriculture's Conservation Reserve Program (CRP). Also present are significant woodlands, including Classified Forest (an Indiana Department of Natural Resources program) and Palustrine forested wetlands. Ponds and emergent wetlands are also found within the watershed. Black Creek enters Hamilton Lake on the northeast side of the lake between the Clarks Landing and Cold Springs developments.

The watershed is within the Steuben Morainal Lake Physiographic Area, which is a complex morainal topography created by glaciers (Schnieder, A.F. 1966. Physiography. Pages 40-56 *in* Natural Features of Indiana, A.A. Lindsey, ed. Indiana Academy of Science, Indianapolis). There is about 100 feet of elevation difference between the highest ground in the watershed and Hamilton Lake, which is considerable within such a small watershed.

Upstream from County Road 550 East, Black Creek is essentially a channelized ditch. Several ditches enter the main stream, including Haughey Ditch, which drains the west side of the watershed, and the Davis Ditch/Lillian Metz Ditch/Burch Ditch system which drains the northcentral portion of the watershed. Other smaller laterals are also present. Downstream of CR 550E Black Creek is essentially natural within an entrenched channel through a hilly area. This lower section is quite wooded, while the channelized section upstream has few trees and has grass along the banks.

Bank erosion is common within the channelized section of Black Creek and its tributaries because of the steep banks and lack of woody vegetation. Streambank stabilization, preferably through native woody plantings but also with riprap where necessary, would help reduce this erosion. Buffer strips along the waterways to separate cropland from the stream channels would help reduce runoff into the streams. The significant amount of CRP land in the watershed reduces runoff from these lands because of the permanent grass/herbaceous vegetation cover; however, if these lands are taken out of CRP, there likely would be increased row-cropping, with resultant increased runoff of soil and nutrients. Landowners should be encouraged to keep erodable lands in CRP or other suitable programs, such as planting to native prairie under the U.S. Fish and Wildlife Service's Partners for Fish and Wildlife Program. A review of the soils data for the watershed (2005 USDA SSURGO) indicates that soil types within the Black Creek watershed vary from slightly erodible to highly erodible, with wind erosion being a problem with muck soils when they are dry and unvegetated, and sheet and rill erosion from water runoff being a problem with sand and clay loams in hilly areas.

Some of the significant woodlands in the watershed are along the streams but most appear to not be directly connected to the waterways, which is likely why forested and scrub-shrub wetlands remain within these woodlands. Enclosures No. 1 and No. 2, the National Wetlands Inventory maps of the area (Hamilton and Edon Quadrangles) show the numerous wetlands in the watershed. However, these maps were based upon 1983 aerial photography and do not necessarily reflect the current extent of wetlands, including ponds that have been constructed since that time. Restoration of drained wetlands, enhancement of degraded wetlands, and preservation of existing high quality wetlands could help improve water quality in the watershed.

A former landfill of about 18 acres, which has been inactive for 20 years, is located on the north side of CR 450S, between CR 600E and CR 700E, just north of Black Creek. We understand that there has been significant erosion from this site in the past but do not know the current status. An attempt to establish a new landfill on adjacent lands was not allowed.

ENDANGERED SPECIES

The proposed project is within the range of the Federally endangered Indiana bat (Myotis sodalis), the threatened bald eagle (Haliaeetus leucocephalus) and northern copperbelly water snake (Nerodia erythrogaster neglecta), and the candidate eastern massasauga rattlesnake (Sistrurus catenatus catenatus).

There may be suitable summer maternity habitat for the Indiana bat along the lower wooded portion of Black Creek and within the various large woodlands. Maternity colonies occupy roost sites in forested floodplain or upland habitats and are very loyal to their roosts and nightly foraging area, which are usually centered over riparian forests. Females and their young utilize both primary and secondary roosts, with the roosts usually being under exfoliating bark or living or dead trees, although tree cavities are also sometimes used.

Bald eagles do not nest in Steuben County but they are occasional visitors to the lakes of northern Indiana, particularly during winter. There is no specific habitat for the bald eagle in the Black Creek Watershed.

The northern copperbelly water snake is known from the adjacent Fish Creek Watershed, so has been found within a few miles of the Black Creek Watershed. Suitable habitat for this species in the form of Palustrine forested and scrub-shrub wetlands and adjacent upland woodlands are present with the Black Creek Watershed. We do not have specific information on the presence or absence of this species within the Black Creek Watershed, but if it is present it would likely benefit from

preservation of existing forested/scrub-shrub wetlands, the restoration of additional wetlands, and the planting of riparian corridors. Depending upon the location of project activities, pre-construction surveys for the northern copperbelly may be needed.

The eastern massasauga is found in relatively open habitats such as wet prairies, sedge meadows, and old fields, and tends to avoid heavily wooded areas. Since many of the wetlands in the Black Creek Watershed are forested or scrub-shrub, the open grassy wetlands that massasaugas require do not appear to be present. However, depending upon the location of project activities, pre-construction surveys for this species may be warranted.

These endangered species comments constitute informal consultation only. They do not fulfill the requirements of Section 7 of the Endangered Species Act of 1973, as amended.

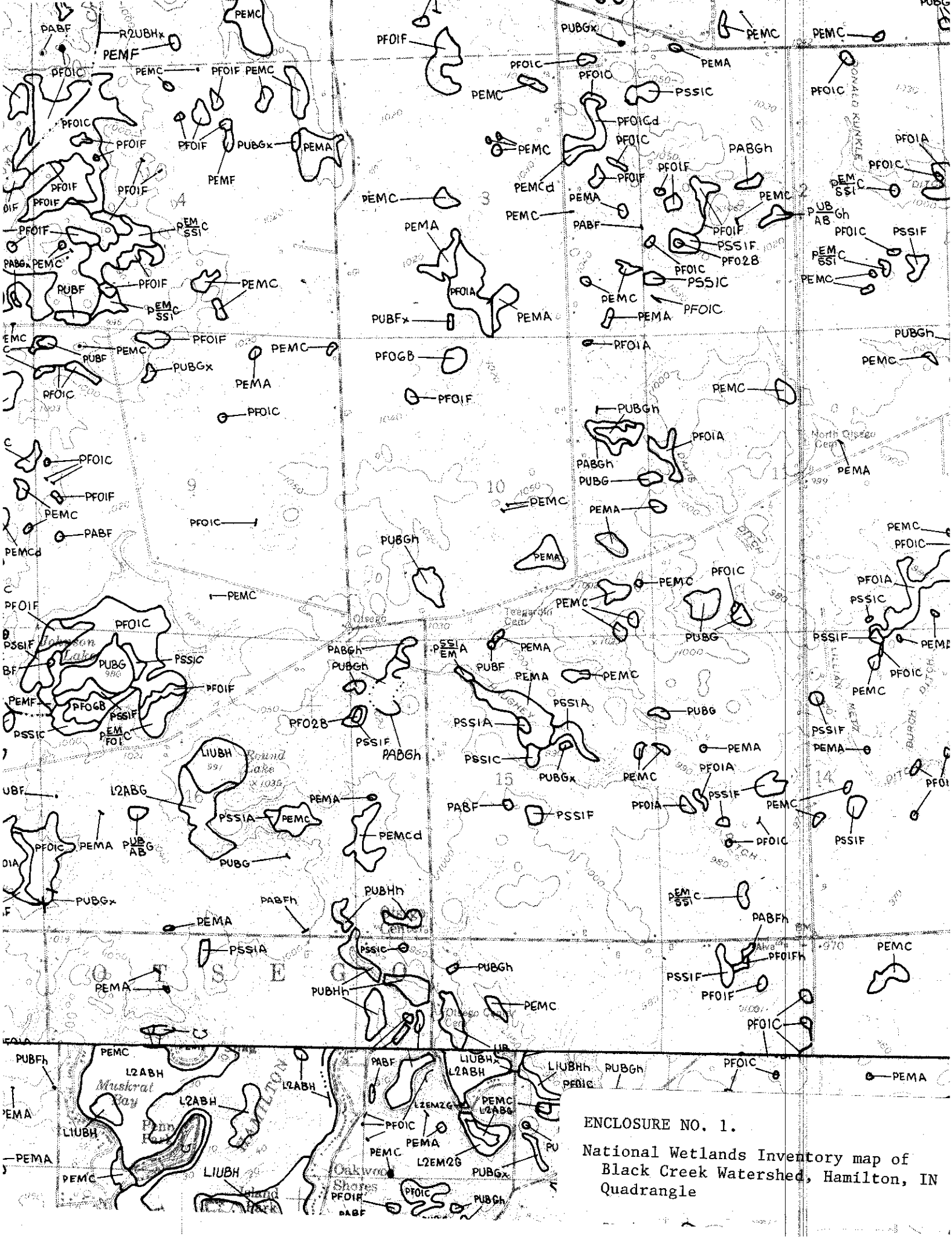
We appreciate the opportunity to comment at this early stage of project planning. Please keep us informed about project planning as it progresses. If you have any questions, please contact Elizabeth McCloskey at (219) 983-9753 or elizabeth_mccloskey@fws.gov.

Sincerely yours,

Elizabeth S. McCloskey

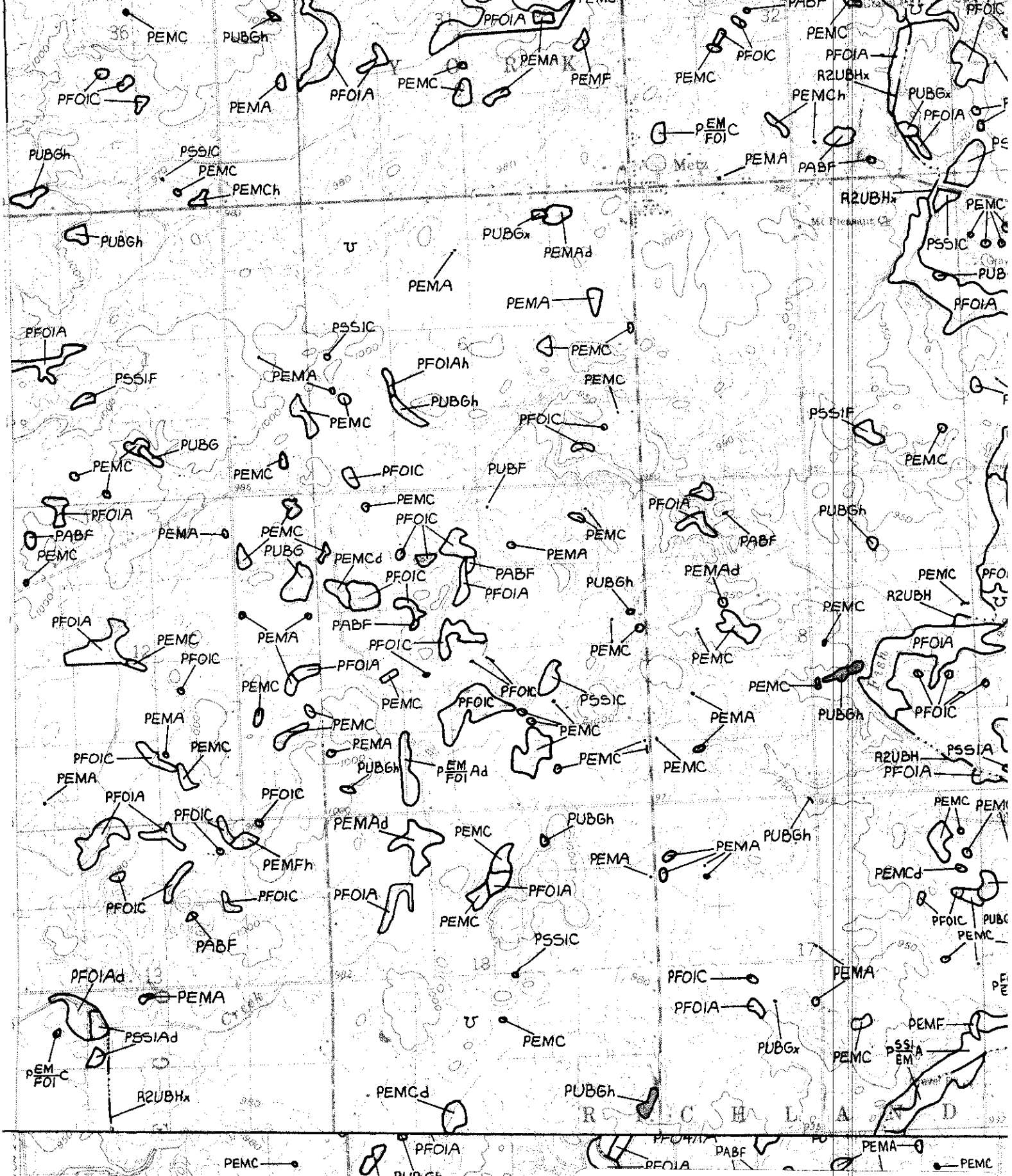
for Scott E. Pruitt
Supervisor

cc: Christie Stanifer, Environmental Coordinator, Division of Water, Indianapolis
LARE Section, Division of Fish and Wildlife, Indianapolis, IN
IDEM, Office of Water Management, Indianapolis, IN




ENCLOSURE NO. 1.

National Wetlands Inventory map of Black Creek Watershed, Hamilton, IN Quadrangle




ENCLOSURE NO. 2.

National Wetlands Inventory map of Black Creek Watershed, Edon, IN Quadrangle

# APPENDIX F

## Environmental Assessment

We have opted to mimic the guidelines of the U.S. Environmental Protection Agency's Clean Lakes Program in order to assess the environmental effects of proposed projects in the five small subwatersheds. These guidelines involve a checklist approach to impact assessment and can be found in the Code of Federal Regulations, Title 40, Part 35, Subpart H. These guidelines involve 14 questions which may be satisfactorily answered with a mere "Yes" or "No", but should detail important benefits or adverse effects sufficiently to allow for mitigation planning during the design and implementation phases.

None of the proposed projects have significant adverse effects on the physical, biological or social environment. The small scale of the proposed projects limit their adverse effects on environmental resources.

| Issue | Streambank Stabilization | Buffer Strips | Grade Control |
|---|---|---|---|
| Will the proposed project displace any people? | No | No | No |
| Will the proposed project deface existing residences or residential areas? What mitigative actions such as landscaping, screening, or buffer zones have been considered? Are they included? | No. Landscaping will be included in the design of the streambank stabilization. | No. Landscaping will be included in the design of the buffer strips. | No |
| Will the proposed project be likely to lead to a change in established land use patterns, such as increased development pressure near the lake? To what extent and how will this change be controlled through land use planning, zoning, or through other methods? | No | Conversion of agricultural land to grassland and tree buffers. | No |
| Will the proposed project adversely affect a significant amount of prime agricultural land or agricultural operations on such land? | No | No. Although buffer strips will take approximately 30 feet of agricultural land along select portions of stream. | No |
| Will the proposed project result in a significant adverse effect on parkland, other public land, or lands of recognized scenic value? | No | No | No |
| Has the State Historical Society or State Historical Preservation Officer been contacted? Has he responded, and if so, what was the nature of that response? Will the proposed project result in a significant adversely effect on lands or structures of historic, architectural, archaeological or cultural value? | The SHPO has not been contacted but none of the proposed projects will affect historic structures or known cultural resources. | The SHPO has not been contacted but none of the proposed projects will affect historic structures or known cultural resources. | The SHPO has not been contacted but none of the proposed projects will affect historic structures or known cultural resources. |
| Will the proposed project lead to a significant long-range increase in energy demands? | No | No | No |
| Will the proposed project result in significant and long range adverse changes in ambient air quality or noise levels? Short term? | No | No | No |
| If the proposed project involves the use of in-lake chemical treatment, what long and short term adverse effects can be expected from that treatment? How will the project recipient mitigate these effects? | No in-lake treatments proposed. | No in-lake treatments proposed. | No in-lake treatments proposed. |
| Is the proposed project located in a floodplain? If so, will the project involve construction of structures in the floodplain? What steps will be taken to reduce the possible effects of flood damage to the project? | Yes. Design improvement is to mitigate against damage from high flow events. Structures will adequately anchored and reinforced to withstand flood flow forces. | Possibly. Erosion control matting installation might be required depending on flood flow velocities. | Yes. Design improvement is to mitigate against damage from high flow events. Structures will adequately anchored and reinforced to withstand flood flow forces. |
| If the project involves physically modifying the lake shore or its bed or its watershed, by dredging, for example, what steps will be taken to minimize any immediate and long term adverse effects of such activities? When dredging is employed, where will the dredged material be deposited, what can be expected and what measures will the local sponsor employ to minimize any significant adverse impacts from its | Project is designed to reduce sediment and sediment-related pollutant loads to the lake. | Project is designed to reduce sediment and sediment-related pollutant loads to the lake. | Project is designed to reduce sediment and sediment-related pollutant loads to the lake. |

| Issue | Streambank Stabilization | Buffer Strips | Grade Control |
|---|---|---|---|
| deposition? | | | |
| Will the proposed project have a significant adverse effect on fish and wildlife, or on wetlands or any other wildife habitat, especially those of endangered species? How significant is this impact in relation to the local or regional critical habitat needs? Have actions to mit igate habitat destruction been incorporated into the project? Has the recipient properly consulted with appropriate State and Federal fish, game and wildlife agencies and with the U.S. Fish and Wildlife Service? What were their replies? | Negligible affects on fish, wildlife or protected resources. | Positive impact on wildlife and wildlife habitat. | Negligible affects on fish, wildlife or protected resources. |
| Describe any feasible alternatives to the proposed project and why they were not proposed. | Constructed wetlands – site specific location (dense forested area) lead to potential construction difficulties and high cost. | Constructed wetlands – site specific location (dense forested area) lead to potential construction difficulties and high cost. | Constructed wetlands – site specific location (dense forested area) lead to potential construction difficulties and high cost. |
| Describe other measures not discussed previously that are necessary to mitigate adverse environmental impacts resulting from the implementat ion of the proposed project. | NA | NA | NA |

# APPENDIX G

Date: 4/15/06

# Citizens Qualitative Habitat Evaluation Index

40 CQHEI Total

Vol ID: | Site ID: 2 | River and Watershed: Metz Ditch @ E Teegardin

## I. Substrate (Bottom Type) Score: 5

### a) Size

- [ ] 14 pt Mostly Large (Fist Size or Bigger)
- [ ] 6 pt Mostly Small (Smaller Than Fingernail, but Still Coarse, or Bedrock)
- [ ] 10 pt Mostly Medium (Smaller than Fist, but Bigger than Fingernail)
- [x] 0 pt Mostly Very Fine (Not Coarse, Sometimes Greasy or Mucky)

### b) "Smothering"

- [x] NO 5 pt Are Fist Size and Larger Pieces Smothered By Sands/Silts?
- [ ] YES 0 pt Symptoms: Hard to Move Large Pieces, Often Black on Bottom with Few Insects

### c) "Silting"

- [ ] NO 5 pt Are Silts and Clays Distributed Throughout Stream?
- [x] YES 0 pt Symptoms: Light Kicking of Bottom Results in Substantial Clouding of Stream for More than a Minute or Two

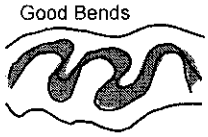
## II. Fish Cover (Hiding Places) - Add 2 Points For Each One Present Score: 2

- [ ] 2 pt Underwater Tree Roots (Large)
- [ ] 2 pt Boulders
- [ ] 2 pt Downed Trees, Logs, Branches
- [ ] 2 pt Water Plants
- [ ] 2 pt Undercut Banks
- [ ] 2 pt Underwater Tree Rootlets (Fine)
- [ ] 2 pt Backwaters, Oxbows or Side Channels
- [ ] 2 pt Shallow, Slow Areas for Small Fish
- [ ] 2 pt Deep Areas (Chest Deep)
- [x] 2 pt Shrubs, Small Trees that Hang Close Over the Bank

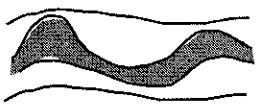
## III. Stream Shape and Human Alterations Score: 15

### a) "Curviness" or "Sinuousity" of Channel

- [ ] 8 pt 2 or More Good Bends



- [x] 6 pt 1 or 2 Good Bends



- [ ] 3 pt Mostly Straight Some "Wiggle"

- [ ] 0 pt Very Straight

### b) How Natural Is The Site?

- [ ] 12 pt Mostly Natural
- [ ] 6 pt Many Man-made Changes, but still some natural conditions left (e.g., trees, meanders)
- [x] 9 pt A Few Minor Man-made Changes (e.g., a bridge, some streambank changes)
- [ ] 0 pt Heavy, Man-made Changes (e.g., leveed or channelized)

## IV. Stream Forests & Wetlands (Riparian Area) & Erosion Score: 13

### a) Width of Riparian Forest & Wetland - Mostly:

- [ ] 8 pt Wide (Can't Throw A Rock Through/ Across It)
- [x] 5 pt Narrow (Can Throw A Rock Through/ Across It)
- [ ] 0 pt None

### b) Land Use - Mostly:

- [x] 5 pt Forest/Wetland
- [ ] 4 pt Shrubs
- [ ] 3 pt Overgrown Fields
- [ ] 2 pt Fenced Pasture
- [ ] 2 pt Park (Grass)
- [ ] 2 pt Conservation Tillage
- [ ] 1 pt Suburban
- [ ] 1 pt Row Crop
- [ ] 0 pt Open Pasture
- [ ] 0 pt Urban/ Industrial

### c) Bank Erosion - Typically:

- [ ] 4 pt Stable Hard or Well-Vegetated Banks
- [x] 2 pt Combination of Stable and Eroding Banks
- [ ] 0 pt Raw, Collapsing Banks

### d) How Much of Stream is Shaded?

- [ ] 3 pt Mostly
- [x] 2 pt Partly
- [ ] 0 pt None

## V. Depth & Velocity Score: 1

### a) Deepest Pool is At Least:

- [ ] 8 pt Chest Deep
- [ ] 4 pt Knee Deep
- [ ] 6 pt Waist Deep
- [x] 0 pt Ankle Deep

### b) Check ALL The Flow Types That You See (Add Points):

- [ ] 2 pt Very Fast: Hard to Stand in the Current
- [x] 1 pt Moderate: Slowly Takes Objects Downstream
- [ ] 0 pt None
- [ ] 3 pt Fast: Quickly Takes Objects Downstream
- [ ] 1 pt Slow: Flow Nearly Absent

## VI. Riffles/Runs (Areas Where Current is Fast/Turbulent, Surface May Be Broken) Score: 4

### a) Riffles/Runs Are:

- [ ] 8 pt Knee Deep or Deeper & Fast
- [x] 4 pt Ankle Deep or Less & Slow
- [ ] 6 pt Ankle/Calf Deep & Fast
- [ ] 0 pt Do Not Exist

### b) Riffle/Run Substrates Are:

- [ ] 7 pt Fist Size or Larger
- [x] 0 pt Smaller Than Your Fingernails or Do Not Exist
- [ ] 6 pt Smaller Than Fist Size, but Larger Than Fingernail

Date: 4/15/06

# Citizens Qualitative Habitat Evaluation Index

19 CQHEI Total

Vol ID:

Site ID: 3

River and Watershed: Mutz @ CR 550E

## I. Substrate (Bottom Type) — Score: 0

### a) Size

- [ ] Mostly Large (Fist Size or Bigger) — 14 pt
- [ ] Mostly Small (Smaller Than Fingernail, but Still Coarse, or Bedrock) — 6 pt
- [ ] Mostly Medium (Smaller than Fist, but Bigger than Fingernail) — 10 pt
- [X] Mostly Very Fine (Not Coarse, Sometimes Greasy or Mucky) — 0 pt

### b) "Smothering"

- [ ] NO — Are Fist Size and Larger Pieces Smothered By Sands/Silts? — 5 pt
- [X] YES — 0 pt — Symptoms: Hard to Move Large Pieces, Often Black on Bottom with Few Insects

### c) "Silting"

- [ ] NO — Are Silts and Clays Distributed Throughout Stream? — 5 pt
- [X] YES — 0 pt — Symptoms: Light Kicking of Bottom Results in Substantial Clouding of Stream for More than a Minute or Two

## II. Fish Cover (Hiding Places) - Add 2 Points For Each One Present — Score: 2

- [ ] Underwater Tree Roots (Large) — 2 pt
- [ ] Underwater Tree Rootlets (Fine) — 2 pt
- [ ] Boulders — 2 pt
- [ ] Backwaters, Oxbows or Side Channels — 2 pt
- [ ] Downed Trees, Logs, Branches — 2 pt
- [ ] Shallow, Slow Areas for Small Fish — 2 pt
- [ ] Water Plants — 2 pt
- [ ] Deep Areas (Chest Deep) — 2 pt
- [ ] Undercut Banks — 2 pt
- [X] Shrubs, Small Trees that Hang Close Over the Bank — 2 pt

## III. Stream Shape and Human Alterations — Score: 3

### a) "Curviness" or "Sinuousity" of Channel

- [ ] 2 or More Good Bends — 8 pt
- [ ] 1 or 2 Good Bends — 6 pt
- [X] Mostly Straight Some "Wiggle" — 3 pt
- [ ] Very Straight — 0 pt

### b) How Natural Is The Site?

- [ ] Mostly Natural — 12 pt
- [ ] Many Man-made Changes, but still some natural conditions left (e.g., trees, meanders) — 6 pt
- [ ] A Few Minor Man-made Changes (e.g., a bridge, some streambank changes) — 9 pt
- [X] Heavy, Man-made Changes (e.g., leveed or channelized) — 0 pt

## IV. Stream Forests & Wetlands (Riparian Area) & Erosion — Score: 9

### a) Width of Riparian Forest & Wetland - Mostly:

- [ ] Wide (Can't Throw A Rock Through/ Across It) — 8 pt
- [ ] Narrow (Can Throw A Rock Through/ Across It) — 5 pt
- [X] None — 0 pt

### b) Land Use - Mostly:

- [ ] Forest/Wetland — 5 pt
- [ ] Shrubs — 4 pt
- [ ] Overgrown Fields — 3 pt
- [ ] Fenced Pasture — 2 pt
- [ ] Park (Grass) — 2 pt
- [ ] Conservation Tillage — 2 pt
- [ ] Suburban — 1 pt
- [ ] Row Crop — 1 pt
- [ ] Open Pasture — 0 pt
- [ ] Urban/ Industrial — 0 pt

### c) Bank Erosion - Typically:

- [X] Stable Hard or Well-Vegetated Banks — 4 pt
- [ ] Combination of Stable and Eroding Banks — 2 pt
- [ ] Raw, Collapsing Banks — 0 pt

### d) How Much of Stream is Shaded?

- [ ] Mostly — 3 pt
- [ ] Partly — 2 pt
- [ ] None — 0 pt

## V. Depth & Velocity — Score: 1

### a) Deepest Pool is At Least:

- [ ] Chest Deep — 8 pt
- [ ] Knee Deep — 4 pt
- [ ] Waist Deep — 6 pt
- [X] Ankle Deep — 0 pt

### b) Check ALL The Flow Types That You See (Add Points):

- [ ] Very Fast: Hard to Stand in the Current — 2 pt
- [ ] Fast: Quickly Takes Objects Downstream — 3 pt
- [ ] Moderate: Slowly Takes Objects Downstream — 1 pt
- [X] Slow: Flow Nearly Absent — 1 pt
- [ ] None — 0 pt

## VI. Riffles/Runs (Areas Where Current is Fast/Turbulent, Surface May Be Broken) — Score: 4

### a) Riffles/Runs Are:

- [ ] Knee Deep or Deeper & Fast — 8 pt
- [ ] Ankle/Calf Deep & Fast — 6 pt
- [X] Ankle Deep or Less & Slow — 4 pt
- [ ] Do Not Exist — 0 pt

### b) Riffle/Run Substrates Are:

- [ ] Fist Size or Larger — 7 pt
- [ ] Smaller Than Fist Size, but Larger Than Fingernail — 6 pt
- [X] Smaller Than Your Fingernails or Do Not Exist — 0 pt

Date: 4/19/06

# Citizens Qualitative Habitat Evaluation Index

73
CQHEI Total

Vol ID:

Site ID: 4

River and Watershed: Hughey Ditch @ CR 530 E

## I. Substrate (Bottom Type) Score: 15

### a) Size

- [ ] Mostly Large (Fist Size or Bigger) — 14 pt
- [ ] Mostly Small (Smaller Than Fingernail, but Still Coarse, or Bedrock) — 6 pt
- [x] Mostly Medium (Smaller than Fist, but Bigger than Fingernail) — 10 pt
- [ ] Mostly Very Fine (Not Coarse, Sometimes Greasy or Mucky) — 0 pt

### b) "Smothering"

- [ ] NO — Are Fist Size and Larger Pieces Smothered By Sands/Silts? — 5 pt
- [x] YES — Symptoms: Hard to Move Large Pieces, Often Black on Bottom with Few Insects — 0 pt

### c) "Silting"

- [x] NO — Are Silts and Clays Distributed Throughout Stream? — 5 pt
- [ ] YES — Symptoms: Light Kicking of Bottom Results in Substantial Clouding of Stream for More than a Minute or Two — 0 pt

## II. Fish Cover (Hiding Places) - Add 2 Points For Each One Present Score: 10

- [x] Underwater Tree Roots (Large) — 2 pt
- [ ] Underwater Tree Rootlets (Fine) — 2 pt
- [x] Boulders — 2 pt
- [ ] Backwaters, Oxbows or Side Channels — 2 pt
- [x] Downed Trees, Logs, Branches — 2 pt
- [x] Shallow, Slow Areas for Small Fish — 2 pt
- [ ] Water Plants — 2 pt
- [ ] Deep Areas (Chest Deep) — 2 pt
- [ ] Undercut Banks — 2 pt
- [x] Shrubs, Small Trees that Hang Close Over the Bank — 2 pt

## III. Stream Shape and Human Alterations Score: 16.5

### a) "Curviness" or "Sinuousity" of Channel

- [ ] 2 or More Good Bends — 8 pt
- [x] 1 or 2 Good Bends — 6 pt
- [ ] Mostly Straight Some "Wiggle" — 3 pt
- [ ] Very Straight — 0 pt

### b) How Natural Is The Site?

- [x] Mostly Natural — 12 pt
- [ ] A Few Minor Man-made Changes (e.g., a bridge, some streambank changes) — 9 pt
- [ ] Many Man-made Changes, but still some natural conditions left (e.g., trees, meanders) — 6 pt
- [ ] Heavy, Man-made Changes (e.g., leveed or channelized) — 0 pt

## IV. Stream Forests & Wetlands (Riparian Area) & Erosion Score: 16.5

### a) Width of Riparian Forest & Wetland - Mostly:

- [x] Wide (Can't Throw A Rock Through/ Across It) — 8 pt
- [x] Narrow (Can Throw A Rock Through/ Across It) — 5 pt
- [ ] None — 0 pt

6.5

### b) Land Use - Mostly:

- [x] Forest/Wetland — 5 pt
- [ ] Shrubs — 4 pt
- [x] Overgrown Fields — 3 pt
- [ ] Fenced Pasture — 2 pt
- [ ] Park (Grass) — 2 pt
- [ ] Conservation Tillage — 2 pt
- [ ] Suburban — 1 pt
- [x] Row Crop — 1 pt
- [ ] Open Pasture — 0 pt
- [ ] Urban/ Industrial — 0 pt

3

### c) Bank Erosion - Typically:

- [x] Stable Hard or Well-Vegetated Banks — 4 pt
- [ ] Combination of Stable and Eroding Banks — 2 pt
- [ ] Raw, Collapsing Banks — 0 pt

### d) How Much of Stream is Shaded?

- [x] Mostly — 3 pt
- [ ] Partly — 2 pt
- [ ] None — 0 pt

## V. Depth & Velocity Score: 5

### a) Deepest Pool is At Least:

- [ ] Chest Deep — 8 pt
- [x] Knee Deep — 4 pt
- [ ] Waist Deep — 6 pt
- [ ] Ankle Deep — 0 pt

### b) Check ALL The Flow Types That You See (Add Points):

- [ ] Very Fast: Hard to Stand in the Current — 2 pt
- [ ] Fast: Quickly Takes Objects Downstream — 3 pt
- [x] Moderate: Slowly Takes Objects Downstream — 1 pt
- [ ] Slow: Flow Nearly Absent — 1 pt
- [ ] None — 0 pt

## VI. Riffles/Runs (Areas Where Current is Fast/Turbulent, Surface May Be Broken) Score: 10

### a) Riffles/Runs Are:

- [ ] Knee Deep or Deeper & Fast — 8 pt
- [ ] Ankle/Calf Deep & Fast — 6 pt
- [x] Ankle Deep or Less & Slow — 4 pt
- [ ] Do Not Exist — 0 pt

### b) Riffle/Run Substrates Are:

- [ ] Fist Size or Larger — 7 pt
- [x] Smaller Than Fist Size, but Larger Than Fingernail — 6 pt
- [ ] Smaller Than Your Fingernails or Do Not Exist — 0 pt

Date: 4/15

# Citizens Qualitative Habitat Evaluation Index

46 CQHEI Total

Vol ID:

Site ID: 5

River and Watershed: Hughes Ditch @ CR 6 E

## I. Substrate (Bottom Type) — Score: 0

### a) Size

- ☐ Mostly Large (Fist Size or Bigger) — 14 pt
- ☐ Mostly Small (Smaller Than Fingernail, but Still Coarse, or Bedrock) — 6 pt
- ☐ Mostly Medium (Smaller than Fist, but Bigger than Fingernail) — 10 pt
- ☑ Mostly Very Fine (Not Coarse, Sometimes Greasy or Mucky) — 0 pt

### b) "Smothering"

- ☐ NO — Are Fist Size and Larger Pieces Smothered By Sands/Silts? — 5 pt
- ☑ YES — Symptoms: Hard to Move Large Pieces, Often Black on Bottom with Few Insects — 0 pt

### c) "Silting"

- ☐ NO — Are Silts and Clays Distributed Throughout Stream? — 5 pt
- ☑ YES — Symptoms: Light Kicking of Bottom Results in Substantial Clouding of Stream for More than a Minute or Two — 0 pt

## II. Fish Cover (Hiding Places) - Add 2 Points For Each One Present — Score: 6

- ☑ Underwater Tree Roots (Large) — 2 pt
- ☐ Underwater Tree Rootlets (Fine) — 2 pt
- ☐ Boulders — 2 pt
- ☐ Backwaters, Oxbows or Side Channels — 2 pt
- ☑ Downed Trees, Logs, Branches — 2 pt
- ☐ Shallow, Slow Areas for Small Fish — 2 pt
- ☐ Water Plants — 2 pt
- ☐ Deep Areas (Chest Deep) — 2 pt
- ☐ Undercut Banks — 2 pt
- ☑ Shrubs, Small Trees that Hang Close Over the Bank — 2 pt

## III. Stream Shape and Human Alterations — Score: 16.5

### a) "Curviness" or "Sinuousity" of Channel

- ☐ 2 or More Good Bends — 8 pt
- ☑ 1 or 2 Good Bends — 6 pt
- ☐ Mostly Straight Some "Wiggle" — 3 pt
- ☐ Very Straight — 0 pt

### b) How Natural Is The Site?

- ☑ Mostly Natural — 12 pt
- ☐ Many Man-made Changes, but still some natural conditions left (e.g., trees, meanders) — 6 pt
- ☑ A Few Minor Man-made Changes (e.g., a bridge, some streambank changes) — 9 pt
- ☐ Heavy, Man-made Changes (e.g., leveed or channelized) — 0 pt

10.5

## IV. Stream Forests & Wetlands (Riparian Area) & Erosion — Score: 17.5

### a) Width of Riparian Forest & Wetland - Mostly:

- ☑ Wide (Can't Throw A Rock Through/ Across It) — 8 pt
- ☑ Narrow (Can Throw A Rock Through/ Across It) — 5 pt
- ☐ None — 0 pt

6.5

### b) Land Use - Mostly:

- ☑ Forest/Wetland — 5 pt
- ☑ Shrubs — 4 pt
- ☑ Overgrown Fields — 3 pt
- ☐ Fenced Pasture — 2 pt
- ☐ Park (Grass) — 2 pt

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- ☐ Conservation Tillage — 2 pt
- ☐ Suburban — 1 pt
- ☐ Row Crop — 1 pt
- ☐ Open Pasture — 0 pt
- ☐ Urban/ Industrial — 0 pt

### c) Bank Erosion - Typically:

- ☑ Stable Hard or Well-Vegetated Banks — 4 pt
- ☐ Combination of Stable and Eroding Banks — 2 pt
- ☐ Raw, Collapsing Banks — 0 pt

### d) How Much of Stream is Shaded?

- ☑ Mostly — 3 pt
- ☐ Partly — 2 pt
- ☐ None — 0 pt

## V. Depth & Velocity — Score: 1

### a) Deepest Pool is At Least:

- ☐ Chest Deep — 8 pt
- ☐ Knee Deep — 4 pt
- ☐ Waist Deep — 6 pt
- ☑ Ankle Deep — 0 pt

### b) Check ALL The Flow Types That You See (Add Points):

- ☐ Very Fast: Hard to Stand in the Current — 2 pt
- ☐ Fast: Quickly Takes Objects Downstream — 3 pt
- ☐ Moderate: Slowly Takes Objects Downstream — 1 pt
- ☑ Slow: Flow Nearly Absent — 1 pt
- ☐ None — 0 pt

## VI. Riffles/Runs (Areas Where Current is Fast/Turbulent, Surface May Be Broken) — Score: 6

### a) Riffles/Runs Are:

- ☐ Knee Deep or Deeper & Fast — 8 pt
- ☑ Ankle/Calf Deep & Fast — 6 pt
- ☐ Ankle Deep or Less & Slow — 4 pt
- ☐ Do Not Exist — 0 pt

### b) Riffle/Run Substrates Are:

- ☐ Fist Size or Larger — 7 pt
- ☐ Smaller Than Fist Size, but Larger Than Fingernail — 6 pt
- ☑ Smaller Than Your Fingernails or Do Not Exist — 0 pt

Date: 4/15

# Citizens Qualitative Habitat Evaluation Index

42.5 CQHEI Total

Vol ID:

Site ID: 6

River and Watershed: Hayley Ditch @ SOS

## I. Substrate (Bottom Type) — Score: 0

### a) Size

- [ ] Mostly Large (Fist Size or Bigger) — 14 pt
- [ ] Mostly Small (Smaller Than Fingernail, but Still Coarse, or Bedrock) — 6 pt
- [ ] Mostly Medium (Smaller than Fist, but Bigger than Fingernail) — 10 pt
- [x] Mostly Very Fine (Not Coarse, Sometimes Greasy or Mucky) — 0 pt

### b) "Smothering"

- [ ] NO — Are Fist Size and Larger Pieces Smothered By Sands/Silts? — 5 pt
- [x] YES — Symptoms: Hard to Move Large Pieces, Often Black on Bottom with Few Insects — 0 pt

### c) "Silting"

- [ ] NO — Are Silts and Clays Distributed Throughout Stream? — 5 pt
- [x] YES — Symptoms: Light Kicking of Bottom Results in Substantial Clouding of Stream for More than a Minute or Two — 0 pt

## II. Fish Cover (Hiding Places) - Add 2 Points For Each One Present — Score: 8

- [x] Underwater Tree Roots (Large) — 2 pt
- [ ] Boulders — 2 pt
- [x] Downed Trees, Logs, Branches — 2 pt
- [ ] Water Plants — 2 pt
- [ ] Undercut Banks — 2 pt
- [ ] Underwater Tree Rootlets (Fine) — 2 pt
- [ ] Backwaters, Oxbows or Side Channels — 2 pt
- [x] Shallow, Slow Areas for Small Fish — 2 pt
- [ ] Deep Areas (Chest Deep) — 2 pt
- [x] Shrubs, Small Trees that Hang Close Over the Bank — 2 pt

## III. Stream Shape and Human Alterations — Score: 13.5

### a) "Curviness" or "Sinuousity" of Channel

- [ ] 2 or More Good Bends — 8 pt
- [ ] 1 or 2 Good Bends — 6 pt
- [x] Mostly Straight Some "Wiggle" — 3 pt
- [ ] Very Straight — 0 pt

### b) How Natural Is The Site?

- [x] Mostly Natural — 12 pt
- [ ] Many Man-made Changes, but still some natural conditions left (e.g., trees, meanders) — 6 pt
- [x] A Few Minor Man-made Changes (e.g., a bridge, some streambank changes) — 9 pt
- [ ] Heavy, Man-made Changes (e.g., leveed or channelized) — 0 pt

10.5

## IV. Stream Forests & Wetlands (Riparian Area) & Erosion — Score: 16

### a) Width of Riparian Forest & Wetland - Mostly:

- [ ] Wide (Can't Throw A Rock Through/ Across It) — 8 pt
- [x] Narrow (Can Throw A Rock Through/ Across It) — 5 pt
- [ ] None — 0 pt

### b) Land Use - Mostly:

- [x] Forest/Wetland — 5 pt
- [ ] Conservation Tillage — 2 pt
- [x] Shrubs — 4 pt
- [ ] Suburban — 1 pt
- [x] Overgrown Fields — 3 pt
- [ ] Row Crop — 1 pt
- [ ] Fenced Pasture — 2 pt
- [ ] Open Pasture — 0 pt
- [ ] Park (Grass) — 2 pt
- [ ] Urban/ Industrial — 0 pt

4

### c) Bank Erosion - Typically:

- [x] Stable Hard or Well-Vegetated Banks — 4 pt
- [ ] Combination of Stable and Eroding Banks — 2 pt
- [ ] Raw, Collapsing Banks — 0 pt

### d) How Much of Stream is Shaded?

- [x] Mostly — 3 pt
- [ ] Partly — 2 pt
- [ ] None — 0 pt

## V. Depth & Velocity — Score: 1

### a) Deepest Pool is At Least:

- [ ] Chest Deep — 8 pt
- [ ] Knee Deep — 4 pt
- [ ] Waist Deep — 6 pt
- [x] Ankle Deep — 0 pt

### b) Check ALL The Flow Types That You See (Add Points):

- [ ] Very Fast: Hard to Stand in the Current — 2 pt
- [ ] Moderate: Slowly Takes Objects Downstream — 1 pt
- [ ] None — 0 pt
- [ ] Fast: Quickly Takes Objects Downstream — 3 pt
- [x] Slow: Flow Nearly Absent — 1 pt

## VI. Riffles/Runs (Areas Where Current is Fast/Turbulent, Surface May Be Broken) — Score: 4

### a) Riffles/Runs Are:

- [ ] Knee Deep or Deeper & Fast — 8 pt
- [x] Ankle Deep or Less & Slow — 4 pt
- [ ] Ankle/Calf Deep & Fast — 6 pt
- [ ] Do Not Exist — 0 pt

### b) Riffle/Run Substrates Are:

- [ ] Fist Size or Larger — 7 pt
- [x] Smaller Than Your Fingernails or Do Not Exist — 0 pt
- [ ] Smaller Than Fist Size, but Larger Than Fingernail — 6 pt

Date: 4/15

# Citizens Qualitative Habitat Evaluation Index

34
CQHEI Total

Vol ID:

Site ID: 7

River and Watershed: Mid Q 600E

## I. Substrate (Bottom Type) — Score: 0

### a) Size

- [ ] 14 pt — Mostly Large (Fist Size or Bigger)
- [ ] 6 pt — Mostly Small (Smaller Than Fingernail, but Still Coarse, or Bedrock)
- [ ] 10 pt — Mostly Medium (Smaller than Fist, but Bigger than Fingernail)
- [x] 0 pt — Mostly Very Fine (Not Coarse, Sometimes Greasy or Mucky)

### b) "Smothering"

- [ ] NO 5 pt — Are Fist Size and Larger Pieces Smothered By Sands/Silts?
- [x] YES 0 pt — Symptoms: Hard to Move Large Pieces, Often Black on Bottom with Few Insects

### c) "Silting"

- [ ] NO 5 pt — Are Silts and Clays Distributed Throughout Stream?
- [x] YES 0 pt — Symptoms: Light Kicking of Bottom Results in Substantial Clouding of Stream for More than a Minute or Two

## II. Fish Cover (Hiding Places) - Add 2 Points For Each One Present — Score: 10

- [ ] 2 pt — Underwater Tree Roots (Large)
- [ ] 2 pt — Underwater Tree Rootlets (Fine)
- [ ] 2 pt — Boulders
- [ ] 2 pt — Backwaters, Oxbows or Side Channels
- [x] 2 pt — Downed Trees, Logs, Branches
- [x] 2 pt — Shallow, Slow Areas for Small Fish
- [x] 2 pt — Water Plants
- [ ] 2 pt — Deep Areas (Chest Deep)
- [x] 2 pt — Undercut Banks
- [x] 2 pt — Shrubs, Small Trees that Hang Close Over the Bank

## III. Stream Shape and Human Alterations — Score: 3

### a) "Curviness" or "Sinuousity" of Channel

- [ ] 8 pt — 2 or More Good Bends
- [ ] 6 pt — 1 or 2 Good Bends
- [ ] 3 pt — Mostly Straight Some "Wiggle"
- [x] 0 pt — Very Straight

### b) How Natural Is The Site?

- [ ] 12 pt — Mostly Natural
- [x] 6 pt — Many Man-made Changes, but still some natural conditions left (e.g., trees, meanders)
- [ ] 9 pt — A Few Minor Man-made Changes (e.g., a bridge, some streambank changes)
- [x] 0 pt — Heavy, Man-made Changes (e.g., leveed or channelized)

3

## IV. Stream Forests & Wetlands (Riparian Area) & Erosion — Score: 16

### a) Width of Riparian Forest & Wetland - Mostly:

- [x] 8 pt — Wide (Can't Throw A Rock Through/ Across It)
- [x] 5 pt — Narrow (Can Throw A Rock Through/ Across It)
- [ ] 0 pt — None

6.5

### b) Land Use - Mostly:

- [x] 5 pt — Forest/Wetland
- [x] 4 pt — Shrubs
- [x] 3 pt — Overgrown Fields
- [ ] 2 pt — Fenced Pasture
- [ ] 2 pt — Park (Grass)
- [ ] 2 pt — Conservation Tillage
- [ ] 1 pt — Suburban
- [ ] 1 pt — Row Crop
- [ ] 0 pt — Open Pasture
- [ ] 0 pt — Urban/ Industrial

4

### c) Bank Erosion - Typically:

- [x] 4 pt — Stable Hard or Well-Vegetated Banks
- [x] 2 pt — Combination of Stable and Eroding Banks
- [ ] 0 pt — Raw, Collapsing Banks

3

### d) How Much of Stream is Shaded?

- [x] 3 pt — Mostly
- [x] 2 pt — Partly
- [ ] 0 pt — None

2.5

## V. Depth & Velocity — Score: 5

### a) Deepest Pool is At Least:

- [ ] 8 pt — Chest Deep
- [x] 4 pt — Knee Deep
- [ ] 6 pt — Waist Deep
- [ ] 0 pt — Ankle Deep

### b) Check ALL The Flow Types That You See (Add Points):

- [ ] 2 pt — Very Fast: Hard to Stand in the Current
- [ ] 3 pt — Fast: Quickly Takes Objects Downstream
- [ ] 1 pt — Moderate: Slowly Takes Objects Downstream
- [x] 1 pt — Slow: Flow Nearly Absent
- [ ] 0 pt — None

## VI. Riffles/Runs (Areas Where Current is Fast/Turbulent, Surface May Be Broken) — Score: 0

### a) Riffles/Runs Are:

- [ ] 8 pt — Knee Deep or Deeper & Fast
- [ ] 6 pt — Ankle/Calf Deep & Fast
- [ ] 4 pt — Ankle Deep or Less & Slow
- [x] 0 pt — Do Not Exist

### b) Riffle/Run Substrates Are:

- [ ] 7 pt — Fist Size or Larger
- [ ] 6 pt — Smaller Than Fist Size, but Larger Than Fingernail
- [x] 0 pt — Smaller Than Your Fingernails or Do Not Exist

Date: 4/15

# Citizens Qualitative Habitat Evaluation Index

24 CQHEI Total

Vol ID:

Site ID: 8

River and Watershed: Birch @ 600-E

## I. Substrate (Bottom Type) — Score: 0

### a) Size

- [ ] Mostly Large (Fist Size or Bigger) — 14 pt
- [ ] Mostly Small (Smaller Than Fingernail, but Still Coarse, or Bedrock) — 6 pt
- [ ] Mostly Medium (Smaller than Fist, but Bigger than Fingernail) — 10 pt
- [x] Mostly Very Fine (Not Coarse, Sometimes Greasy or Mucky) — 0 pt

### b) "Smothering"

- [ ] NO — Are Fist Size and Larger Pieces Smothered By Sands/Silts? — 5 pt
- [x] YES — Symptoms: Hard to Move Large Pieces, Often Black on Bottom with Few Insects — 0 pt

### c) "Silting"

- [ ] NO — Are Silts and Clays Distributed Throughout Stream? — 5 pt
- [x] YES — Symptoms: Light Kicking of Bottom Results in Substantial Clouding of Stream for More than a Minute or Two — 0 pt

## II. Fish Cover (Hiding Places) - Add 2 Points For Each One Present — Score: 6

- [ ] Underwater Tree Roots (Large) — 2 pt
- [ ] Underwater Tree Rootlets (Fine) — 2 pt
- [ ] Boulders — 2 pt
- [ ] Backwaters, Oxbows or Side Channels — 2 pt
- [x] Downed Trees, Logs, Branches — 2 pt
- [x] Shallow, Slow Areas for Small Fish — 2 pt
- [ ] Water Plants — 2 pt
- [ ] Deep Areas (Chest Deep) — 2 pt
- [ ] Undercut Banks — 2 pt
- [x] Shrubs, Small Trees that Hang Close Over the Bank — 2 pt

## III. Stream Shape and Human Alterations — Score: 0

### a) "Curviness" or "Sinuousity" of Channel

- [ ] 2 or More Good Bends — 8 pt
- [ ] 1 or 2 Good Bends — 6 pt
- [ ] Mostly Straight Some "Wiggle" — 3 pt
- [x] Very Straight — 0 pt

### b) How Natural Is The Site?

- [ ] Mostly Natural — 12 pt
- [ ] Many Man-made Changes, but still some natural conditions left (e.g., trees, meanders) — 6 pt
- [ ] A Few Minor Man-made Changes (e.g., a bridge, some streambank changes) — 9 pt
- [x] Heavy, Man-made Changes (e.g., leveed or channelized) — 0 pt

## IV. Stream Forests & Wetlands (Riparian Area) & Erosion — Score: 8.9

### a) Width of Riparian Forest & Wetland - Mostly:

- [ ] Wide (Can't Throw A Rock Through/ Across It) — 8 pt
- [x] Narrow (Can Throw A Rock Through/ Across It) — 5 pt
- [x] None — 0 pt

2.5

### b) Land Use - Mostly:

- [x] Forest/Wetland — 5 pt
- [x] Shrubs — 4 pt
- [ ] Overgrown Fields — 3 pt
- [x] Fenced Pasture — 2 pt
- [ ] Park (Grass) — 2 pt

2.4

- [ ] Conservation Tillage — 2 pt
- [ ] Suburban — 1 pt
- [x] Row Crop — 1 pt
- [x] Open Pasture — 0 pt
- [ ] Urban/ Industrial — 0 pt

### c) Bank Erosion - Typically:

- [ ] Stable Hard or Well-Vegetated Banks — 4 pt
- [x] Combination of Stable and Eroding Banks — 2 pt
- [ ] Raw, Collapsing Banks — 0 pt

### d) How Much of Stream is Shaded?

- [ ] Mostly — 3 pt
- [x] Partly — 2 pt
- [ ] None — 0 pt

## V. Depth & Velocity — Score: 5

### a) Deepest Pool is At Least:

- [ ] Chest Deep — 8 pt
- [x] Knee Deep — 4 pt
- [ ] Waist Deep — 6 pt
- [ ] Ankle Deep — 0 pt

### b) Check ALL The Flow Types That You See (Add Points):

- [ ] Very Fast: Hard to Stand in the Current — 2 pt
- [ ] Fast: Quickly Takes Objects Downstream — 3 pt
- [ ] Moderate: Slowly Takes Objects Downstream — 1 pt
- [x] Slow: Flow Nearly Absent — 1 pt
- [ ] None — 0 pt

## VI. Riffles/Runs (Areas Where Current is Fast/Turbulent, Surface May Be Broken) — Score: 4

### a) Riffles/Runs Are:

- [ ] Knee Deep or Deeper & Fast — 8 pt
- [x] Ankle Deep or Less & Slow — 4 pt
- [ ] Ankle/Calf Deep & Fast — 6 pt
- [ ] Do Not Exist — 0 pt

### b) Riffle/Run Substrates Are:

- [ ] Fist Size or Larger — 7 pt
- [ ] Smaller Than Fist Size, but Larger Than Fingernail — 6 pt
- [x] Smaller Than Your Fingernails or Do Not Exist — 0 pt

Date: 4/15

# Citizens Qualitative Habitat Evaluation Index

38 CQHEI Total

Vol ID:

Site ID: 9

River and Watershed: Unnamed Branch @ 4505

## I. Substrate (Bottom Type) — Score: 3

### a) Size

- [ ] Mostly Large (Fist Size or Bigger) — 14 pt
- [x] Mostly Small (Smaller Than Fingernail, but Still Coarse, or Bedrock) — 6 pt
- [ ] Mostly Medium (Smaller than Fist, but Bigger than Fingernail) — 10 pt
- [x] Mostly Very Fine (Not Coarse, Sometimes Greasy or Mucky) — 0 pt

3

### b) "Smothering"

- [ ] NO — Are Fist Size and Larger Pieces Smothered By Sands/Silts? — 5 pt
- [x] YES — Symptoms: Hard to Move Large Pieces, Often Black on Bottom with Few Insects — 0 pt

### c) "Silting"

- [ ] NO — Are Silts and Clays Distributed Throughout Stream? — 5 pt
- [x] YES — Symptoms: Light Kicking of Bottom Results in Substantial Clouding of Stream for More than a Minute or Two — 0 pt

## II. Fish Cover (Hiding Places) - Add 2 Points For Each One Present — Score: 8

- [ ] Underwater Tree Roots (Large) — 2 pt
- [ ] Boulders — 2 pt
- [x] Downed Trees, Logs, Branches — 2 pt
- [x] Water Plants — 2 pt
- [ ] Undercut Banks — 2 pt
- [x] Underwater Tree Rootlets (Fine) — 2 pt
- [ ] Backwaters, Oxbows or Side Channels — 2 pt
- [ ] Shallow, Slow Areas for Small Fish — 2 pt
- [ ] Deep Areas (Chest Deep) — 2 pt
- [x] Shrubs, Small Trees that Hang Close Over the Bank — 2 pt

## III. Stream Shape and Human Alterations — Score: 7.5

### a) "Curviness" or "Sinuousity" of Channel

- [ ] 2 or More Good Bends — 8 pt
- [ ] 1 or 2 Good Bends — 6 pt
- [x] Mostly Straight Some "Wiggle" — 3 pt
- [x] Very Straight — 0 pt

1.5

### b) How Natural Is The Site?

- [x] Mostly Natural — 12 pt
- [ ] Many Man-made Changes, but still some natural conditions left (e.g., trees, meanders) — 6 pt
- [ ] A Few Minor Man-made Changes (e.g., a bridge, some streambank changes) — 9 pt
- [x] Heavy, Man-made Changes (e.g., leveed or channelized) — 0 pt

6

## IV. Stream Forests & Wetlands (Riparian Area) & Erosion — Score: 12.5

### a) Width of Riparian Forest & Wetland - Mostly:

- [x] Wide (Can't Throw A Rock Through/ Across It) — 8 pt
- [ ] Narrow (Can Throw A Rock Through/ Across It) — 5 pt
- [x] None — 0 pt

4

### b) Land Use - Mostly:

- [x] Forest/Wetland — 5 pt
- [x] Shrubs — 4 pt
- [x] Overgrown Fields — 3 pt
- [ ] Fenced Pasture — 2 pt
- [ ] Park (Grass) — 2 pt
- [ ] Conservation Tillage — 2 pt
- [ ] Suburban — 1 pt
- [ ] Row Crop — 1 pt
- [x] Open Pasture — 0 pt
- [ ] Urban/ Industrial — 0 pt

3

### c) Bank Erosion - Typically:

- [x] Stable Hard or Well-Vegetated Banks — 4 pt
- [ ] Combination of Stable and Eroding Banks — 2 pt
- [ ] Raw, Collapsing Banks — 0 pt

### d) How Much of Stream is Shaded?

- [x] Mostly — 3 pt
- [ ] Partly — 2 pt
- [x] None — 0 pt

1.5

## V. Depth & Velocity — Score: 3

### a) Deepest Pool is At Least:

- [ ] Chest Deep — 8 pt
- [x] Knee Deep — 4 pt
- [ ] Waist Deep — 6 pt
- [x] Ankle Deep — 0 pt

2

### b) Check ALL The Flow Types That You See (Add Points):

- [ ] Very Fast: Hard to Stand in the Current — 2 pt
- [x] Moderate: Slowly Takes Objects Downstream — 1 pt
- [ ] None — 0 pt
- [ ] Fast: Quickly Takes Objects Downstream — 3 pt
- [ ] Slow: Flow Nearly Absent — 1 pt

## VI. Riffles/Runs (Areas Where Current is Fast/Turbulent, Surface May Be Broken) — Score: 4

### a) Riffles/Runs Are:

- [ ] Knee Deep or Deeper & Fast — 8 pt
- [x] Ankle Deep or Less & Slow — 4 pt
- [ ] Ankle/Calf Deep & Fast — 6 pt
- [ ] Do Not Exist — 0 pt

### b) Riffle/Run Substrates Are:

- [ ] Fist Size or Larger — 7 pt
- [x] Smaller Than Your Fingernails or Do Not Exist — 0 pt
- [ ] Smaller Than Fist Size, but Larger Than Fingernail — 6 pt

Date: 4/15

# Citizens Qualitative Habitat Evaluation Index

18.5 CQHEI Total

Vol ID:

Site ID: 10

River and Watershed: Black Creek @ 450S

## I. Substrate (Bottom Type) — Score: 0

### a) Size

- [ ] Mostly Large (Fist Size or Bigger) — 14 pt
- [ ] Mostly Small (Smaller Than Fingernail, but Still Coarse, or Bedrock) — 6 pt
- [ ] Mostly Medium (Smaller than Fist, but Bigger than Fingernail) — 10 pt
- [x] Mostly Very Fine (Not Coarse, Sometimes Greasy or Mucky) — 0 pt

### b) "Smothering"

- [ ] NO — 5 pt — Are Fist Size and Larger Pieces Smothered By Sands/Silts?
- [x] YES — 0 pt — Symptoms: Hard to Move Large Pieces, Often Black on Bottom with Few Insects

### c) "Silting"

- [ ] NO — 5 pt — Are Silts and Clays Distributed Throughout Stream?
- [x] YES — 0 pt — Symptoms: Light Kicking of Bottom Results in Substantial Clouding of Stream for More than a Minute or Two

## II. Fish Cover (Hiding Places) - Add 2 Points For Each One Present — Score: 4

- [ ] Underwater Tree Roots (Large) — 2 pt
- [ ] Boulders — 2 pt
- [x] Downed Trees, Logs, Branches — 2 pt
- [ ] Water Plants — 2 pt
- [ ] Undercut Banks — 2 pt
- [ ] Underwater Tree Rootlets (Fine) — 2 pt
- [ ] Backwaters, Oxbows or Side Channels — 2 pt
- [x] Shallow, Slow Areas for Small Fish — 2 pt
- [ ] Deep Areas (Chest Deep) — 2 pt
- [x] Shrubs, Small Trees that Hang Close Over the Bank — 2 pt

## III. Stream Shape and Human Alterations — Score: 0

### a) "Curviness" or "Sinuousity" of Channel

- [ ] 2 or More Good Bends — 8 pt
- [ ] 1 or 2 Good Bends — 6 pt
- [ ] Mostly Straight Some "Wiggle" — 3 pt
- [x] Very Straight — 0 pt

### b) How Natural Is The Site?

- [ ] Mostly Natural — 12 pt
- [ ] Many Man-made Changes, but still some natural conditions left (e.g., trees, meanders) — 6 pt
- [ ] A Few Minor Man-made Changes (e.g., a bridge, some streambank changes) — 9 pt
- [x] Heavy, Man-made Changes (e.g., leveed or channelized) — 0 pt

## IV. Stream Forests & Wetlands (Riparian Area) & Erosion — Score: 5.5

### a) Width of Riparian Forest & Wetland - Mostly:

- [ ] Wide (Can't Throw A Rock Through/ Across It) — 8 pt
- [ ] Narrow (Can Throw A Rock Through/ Across It) — 5 pt
- [x] None — 0 pt

### b) Land Use - Mostly:

- [ ] Forest/Wetland — 5 pt
- [ ] Conservation Tillage — 2 pt
- [ ] Shrubs — 4 pt
- [ ] Suburban — 1 pt
- [ ] Overgrown Fields — 3 pt
- [x] Row Crop — 1 pt
- [ ] Fenced Pasture — 2 pt
- [ ] Open Pasture — 0 pt
- [x] Park (Grass) — 2 pt — 1.5
- [ ] Urban/ Industrial — 0 pt

### c) Bank Erosion - Typically:

- [x] Stable Hard or Well-Vegetated Banks — 4 pt
- [ ] Combination of Stable and Eroding Banks — 2 pt
- [ ] Raw, Collapsing Banks — 0 pt

### d) How Much of Stream is Shaded?

- [ ] Mostly — 3 pt
- [ ] Partly — 2 pt
- [x] None — 0 pt

## V. Depth & Velocity — Score: 5

### a) Deepest Pool is At Least:

- [ ] Chest Deep — 8 pt
- [x] Knee Deep — 4 pt
- [ ] Waist Deep — 6 pt
- [ ] Ankle Deep — 0 pt

### b) Check ALL The Flow Types That You See (Add Points):

- [ ] Very Fast: Hard to Stand in the Current — 2 pt
- [ ] Moderate: Slowly Takes Objects Downstream — 1 pt
- [ ] None — 0 pt
- [ ] Fast: Quickly Takes Objects Downstream — 3 pt
- [x] Slow: Flow Nearly Absent — 1 pt

## VI. Riffles/Runs (Areas Where Current is Fast/Turbulent, Surface May Be Broken) — Score: 4

### a) Riffles/Runs Are:

- [ ] Knee Deep or Deeper & Fast — 8 pt
- [x] Ankle Deep or Less & Slow — 4 pt
- [ ] Ankle/Calf Deep & Fast — 6 pt
- [ ] Do Not Exist — 0 pt

### b) Riffle/Run Substrates Are:

- [ ] Fist Size or Larger — 7 pt
- [x] Smaller Than Your Fingernails or Do Not Exist — 0 pt
- [ ] Smaller Than Fist Size, but Larger Than Fingernail — 6 pt

Date: 4/15

# Citizens Qualitative Habitat Evaluation Index

44.5
CQHEI Total

Vol ID:

Site ID: 11

River and Watershed: Black Creek and Goose

## I. Substrate (Bottom Type) — Score: 13.5

### a) Size

- [ ] Mostly Large (Fist Size or Bigger) — 14 pt
- [x] Mostly Small (Smaller Than Fingernail, but Still Coarse, or Bedrock) — 6 pt
- [ ] Mostly Medium (Smaller than Fist, but Bigger than Fingernail) — 10 pt
- [ ] Mostly Very Fine (Not Coarse, Sometimes Greasy or Mucky) — 0 pt

### b) "Smothering"

- [x] NO — Are Fist Size and Larger Pieces Smothered By Sands/Silts? — 5 pt
- [ ] YES — Symptoms: Hard to Move Large Pieces, Often Black on Bottom with Few Insects — 0 pt

### c) "Silting"

- [x] NO — Are Silts and Clays Distributed Throughout Stream? — 5 pt
- [x] YES — Symptoms: Light Kicking of Bottom Results in Substantial Clouding of Stream for More than a Minute or Two — 0 pt

2.5

## II. Fish Cover (Hiding Places) - Add 2 Points For Each One Present — Score: 8

- [ ] Underwater Tree Roots (Large) — 2 pt
- [x] Underwater Tree Rootlets (Fine) — 2 pt
- [ ] Boulders — 2 pt
- [ ] Backwaters, Oxbows or Side Channels — 2 pt
- [x] Downed Trees, Logs, Branches — 2 pt
- [x] Shallow, Slow Areas for Small Fish — 2 pt
- [ ] Water Plants — 2 pt
- [ ] Deep Areas (Chest Deep) — 2 pt
- [ ] Undercut Banks — 2 pt
- [x] Shrubs, Small Trees that Hang Close Over the Bank — 2 pt

## III. Stream Shape and Human Alterations — Score: 3

### a) "Curviness" or "Sinuousity" of Channel

- [ ] 2 or More Good Bends — 8 pt
- [ ] 1 or 2 Good Bends — 6 pt
- [x] Mostly Straight Some "Wiggle" — 3 pt
- [ ] Very Straight — 0 pt

### b) How Natural Is The Site?

- [ ] Mostly Natural — 12 pt
- [ ] Many Man-made Changes, but still some natural conditions left (e.g., trees, meanders) — 6 pt
- [ ] A Few Minor Man-made Changes (e.g., a bridge, some streambank changes) — 9 pt
- [x] Heavy, Man-made Changes (e.g., leveed or channelized) — 0 pt

## IV. Stream Forests & Wetlands (Riparian Area) & Erosion — Score: 12

### a) Width of Riparian Forest & Wetland - Mostly:

- [ ] Wide (Can't Throw A Rock Through/ Across It) — 8 pt
- [x] Narrow (Can Throw A Rock Through/ Across It) — 5 pt
- [ ] None — 0 pt

### b) Land Use - Mostly:

- [x] Forest/Wetland — 5 pt
- [x] Shrubs — 4 pt
- [ ] Overgrown Fields — 3 pt
- [ ] Fenced Pasture — 2 pt
- [x] Park (Grass) — 2 pt
- [ ] Conservation Tillage — 2 pt
- [ ] Suburban — 1 pt
- [x] Row Crop — 1 pt
- [ ] Open Pasture — 0 pt
- [ ] Urban/ Industrial — 0 pt

3

### c) Bank Erosion - Typically:

- [ ] Stable Hard or Well-Vegetated Banks — 4 pt
- [x] Combination of Stable and Eroding Banks — 2 pt
- [ ] Raw, Collapsing Banks — 0 pt

### d) How Much of Stream is Shaded?

- [ ] Mostly — 3 pt
- [x] Partly — 2 pt
- [ ] None — 0 pt

## V. Depth & Velocity — Score: 5

### a) Deepest Pool is At Least:

- [ ] Chest Deep — 8 pt
- [x] Knee Deep — 4 pt
- [ ] Waist Deep — 6 pt
- [ ] Ankle Deep — 0 pt

### b) Check ALL The Flow Types That You See (Add Points):

- [ ] Very Fast: Hard to Stand in the Current — 2 pt
- [x] Moderate: Slowly Takes Objects Downstream — 1 pt
- [ ] None — 0 pt
- [ ] Fast: Quickly Takes Objects Downstream — 3 pt
- [ ] Slow: Flow Nearly Absent — 1 pt

## VI. Riffles/Runs (Areas Where Current is Fast/Turbulent, Surface May Be Broken) — Score: 3

### a) Riffles/Runs Are:

- [ ] Knee Deep or Deeper & Fast — 8 pt
- [ ] Ankle Deep or Less & Slow — 4 pt
- [ ] Ankle/Calf Deep & Fast — 6 pt
- [x] Do Not Exist — 0 pt

### b) Riffle/Run Substrates Are:

- [ ] Fist Size or Larger — 7 pt
- [x] Smaller Than Your Fingernails or Do Not Exist — 0 pt
- [x] Smaller Than Fist Size, but Larger Than Fingernail — 6 pt

3

Date: 4/15

# Citizens Qualitative Habitat Evaluation Index

15 CQHEI Total

Vol ID:

Site ID: 12

River and Watershed: Black Creek 0 5005

## I. Substrate (Bottom Type) — Score: 0

### a) Size

- ☐ 14 pt — Mostly Large (Fist Size or Bigger)
- ☐ 6 pt — Mostly Small (Smaller Than Fingernail, but Still Coarse, or Bedrock)
- ☐ 10 pt — Mostly Medium (Smaller than Fist, but Bigger than Fingernail)
- ☑ 0 pt — Mostly Very Fine (Not Coarse, Sometimes Greasy or Mucky)

### b) "Smothering"

- ☐ NO 5 pt — Are Fist Size and Larger Pieces Smothered By Sands/Silts?
- ☑ YES 0 pt — Symptoms: Hard to Move Large Pieces, Often Black on Bottom with Few Insects

### c) "Silting"

- ☐ NO 5 pt — Are Silts and Clays Distributed Throughout Stream?
- ☑ YES 0 pt — Symptoms: Light Kicking of Bottom Results in Substantial Clouding of Stream for More than a Minute or Two

## II. Fish Cover (Hiding Places) - Add 2 Points For Each One Present — Score: 4

- ☐ 2 pt — Underwater Tree Roots (Large)
- ☐ 2 pt — Underwater Tree Rootlets (Fine)
- ☐ 2 pt — Boulders
- ☐ 2 pt — Backwaters, Oxbows or Side Channels
- ☐ 2 pt — Downed Trees, Logs, Branches
- ☑ 2 pt — Shallow, Slow Areas for Small Fish
- ☐ 2 pt — Water Plants
- ☐ 2 pt — Deep Areas (Chest Deep)
- ☐ 2 pt — Undercut Banks
- ☑ 2 pt — Shrubs, Small Trees that Hang Close Over the Bank

## III. Stream Shape and Human Alterations — Score: 0

### a) "Curviness" or "Sinuousity" of Channel

- ☐ 8 pt — 2 or More Good Bends
- ☐ 6 pt — 1 or 2 Good Bends
- ☐ 3 pt — Mostly Straight Some "Wiggle"
- ☑ 0 pt — Very Straight

### b) How Natural Is The Site?

- ☐ 12 pt — Mostly Natural
- ☐ 6 pt — Many Man-made Changes, but still some natural conditions left (e.g., trees, meanders)
- ☐ 9 pt — A Few Minor Man-made Changes (e.g., a bridge, some streambank changes)
- ☑ 0 pt — Heavy, Man-made Changes (e.g., leveed or channelized)

## IV. Stream Forests & Wetlands (Riparian Area) & Erosion — Score: 6

### a) Width of Riparian Forest & Wetland - Mostly:

- ☐ 8 pt — Wide (Can't Throw A Rock Through/ Across It)
- ☐ 5 pt — Narrow (Can Throw A Rock Through/ Across It)
- ☑ 0 pt — None

### b) Land Use - Mostly:

- ☐ 5 pt — Forest/Wetland
- ☐ 4 pt — Shrubs
- ☐ 3 pt — Overgrown Fields
- ☑ 2 pt — Fenced Pasture
- ☐ 2 pt — Park (Grass)
- ☐ 2 pt — Conservation Tillage
- ☐ 1 pt — Suburban
- ☐ 1 pt — Row Crop
- ☑ 0 pt — Open Pasture
- ☐ 0 pt — Urban/ Industrial

### c) Bank Erosion - Typically:

- ☑ 4 pt — Stable Hard or Well-Vegetated Banks
- ☐ 2 pt — Combination of Stable and Eroding Banks
- ☐ 0 pt — Raw, Collapsing Banks

### d) How Much of Stream is Shaded?

- ☐ 3 pt — Mostly
- ☑ 2 pt — Partly
- ☑ 0 pt — None

## V. Depth & Velocity — Score: 5

### a) Deepest Pool is At Least:

- ☐ 8 pt — Chest Deep
- ☑ 4 pt — Knee Deep
- ☐ 6 pt — Waist Deep
- ☐ 0 pt — Ankle Deep

### b) Check ALL The Flow Types That You See (Add Points):

- ☐ 2 pt — Very Fast: Hard to Stand in the Current
- ☑ 1 pt — Moderate: Slowly Takes Objects Downstream
- ☐ 0 pt — None
- ☐ 3 pt — Fast: Quickly Takes Objects Downstream
- ☐ 1 pt — Slow: Flow Nearly Absent

## VI. Riffles/Runs (Areas Where Current is Fast/Turbulent, Surface May Be Broken) — Score: 0

### a) Riffles/Runs Are:

- ☐ 8 pt — Knee Deep or Deeper & Fast
- ☐ 6 pt — Ankle/Calf Deep & Fast
- ☐ 4 pt — Ankle Deep or Less & Slow
- ☑ 0 pt — Do Not Exist

### b) Riffle/Run Substrates Are:

- ☐ 7 pt — Fist Size or Larger
- ☐ 6 pt — Smaller Than Fist Size, but Larger Than Fingernail
- ☑ 0 pt — Smaller Than Your Fingernails or Do Not Exist

Date: 4/15

# Citizens Qualitative Habitat Evaluation Index

12
CQHEI Total

Vol ID:

Site ID: 16

River and Watershed: Black Creek @ 700E

## I. Substrate (Bottom Type) — Score: 0

### a) Size

- [ ] 14 pt — Mostly Large (Fist Size or Bigger)
- [ ] 6 pt — Mostly Small (Smaller Than Fingernail, but Still Coarse, or Bedrock)
- [ ] 10 pt — Mostly Medium (Smaller than Fist, but Bigger than Fingernail)
- [x] 0 pt — Mostly Very Fine (Not Coarse, Sometimes Greasy or Mucky)

### b) "Smothering"

- [ ] NO 5 pt — Are Fist Size and Larger Pieces Smothered By Sands/Silts?
- [x] YES 0 pt — Symptoms: Hard to Move Large Pieces, Often Black on Bottom with Few Insects

### c) "Silting"

- [ ] NO 5 pt — Are Silts and Clays Distributed Throughout Stream?
- [x] YES 0 pt — Symptoms: Light Kicking of Bottom Results in Substantial Clouding of Stream for More than a Minute or Two

## II. Fish Cover (Hiding Places) - Add 2 Points For Each One Present — Score: 2

- [ ] 2 pt — Underwater Tree Roots (Large)
- [ ] 2 pt — Underwater Tree Rootlets (Fine)
- [ ] 2 pt — Boulders
- [ ] 2 pt — Backwaters, Oxbows or Side Channels
- [ ] 2 pt — Downed Trees, Logs, Branches
- [x] 2 pt — Shallow, Slow Areas for Small Fish
- [ ] 2 pt — Water Plants
- [ ] 2 pt — Deep Areas (Chest Deep)
- [ ] 2 pt — Undercut Banks
- [ ] 2 pt — Shrubs, Small Trees that Hang Close Over the Bank

## III. Stream Shape and Human Alterations — Score: 0

### a) "Curviness" or "Sinuousity" of Channel

- [ ] 8 pt — 2 or More Good Bends
- [ ] 6 pt — 1 or 2 Good Bends
- [ ] 3 pt — Mostly Straight Some "Wiggle"
- [x] 0 pt — Very Straight

### b) How Natural Is The Site?

- [ ] 12 pt — Mostly Natural
- [ ] 6 pt — Many Man-made Changes, but still some natural conditions left (e.g., trees, meanders)
- [ ] 9 pt — A Few Minor Man-made Changes (e.g., a bridge, some streambank changes)
- [x] 0 pt — Heavy, Man-made Changes (e.g., leveed or channelized)

## IV. Stream Forests & Wetlands (Riparian Area) & Erosion — Score: 5

### a) Width of Riparian Forest & Wetland - Mostly:

- [ ] 8 pt — Wide (Can't Throw A Rock Through/ Across It)
- [ ] 5 pt — Narrow (Can Throw A Rock Through/ Across It)
- [x] 0 pt — None

### b) Land Use - Mostly:

- [ ] 5 pt — Forest/Wetland
- [ ] 4 pt — Shrubs
- [ ] 3 pt — Overgrown Fields
- [ ] 2 pt — Fenced Pasture
- [ ] 2 pt — Park (Grass)
- [ ] 2 pt — Conservation Tillage
- [ ] 1 pt — Suburban
- [x] 1 pt — Row Crop
- [ ] 0 pt — Open Pasture
- [ ] 0 pt — Urban/ Industrial

### c) Bank Erosion - Typically:

- [x] 4 pt — Stable Hard or Well-Vegetated Banks
- [ ] 2 pt — Combination of Stable and Eroding Banks
- [ ] 0 pt — Raw, Collapsing Banks

### d) How Much of Stream is Shaded?

- [ ] 3 pt — Mostly
- [ ] 2 pt — Partly
- [x] 0 pt — None

## V. Depth & Velocity — Score: 5

### a) Deepest Pool is At Least:

- [ ] 8 pt — Chest Deep
- [x] 4 pt — Knee Deep
- [ ] 6 pt — Waist Deep
- [ ] 0 pt — Ankle Deep

### b) Check ALL The Flow Types That You See (Add Points):

- [ ] 2 pt — Very Fast: Hard to Stand in the Current
- [ ] 3 pt — Fast: Quickly Takes Objects Downstream
- [ ] 1 pt — Moderate: Slowly Takes Objects Downstream
- [x] 1 pt — Slow: Flow Nearly Absent
- [ ] 0 pt — None

## VI. Riffles/Runs (Areas Where Current is Fast/Turbulent, Surface May Be Broken) — Score: 0

### a) Riffles/Runs Are:

- [ ] 8 pt — Knee Deep or Deeper & Fast
- [ ] 6 pt — Ankle/Calf Deep & Fast
- [ ] 4 pt — Ankle Deep or Less & Slow
- [x] 0 pt — Do Not Exist

### b) Riffle/Run Substrates Are:

- [ ] 7 pt — Fist Size or Larger
- [ ] 6 pt — Smaller Than Fist Size, but Larger Than Fingernail
- [x] 0 pt — Smaller Than Your Fingernails or Do Not Exist

Date: 9/15

# Citizens Qualitative Habitat Evaluation Index

19.5 CQHEI Total

Vol ID: | Site ID: 17 | River and Watershed: Black Creek @ 9005

## I. Substrate (Bottom Type) — Score: 0

### a) Size

- [ ] Mostly Large (Fist Size or Bigger) — 14 pt
- [ ] Mostly Small (Smaller Than Fingernail, but Still Coarse, or Bedrock) — 6 pt
- [ ] Mostly Medium (Smaller than Fist, but Bigger than Fingernail) — 10 pt
- [x] Mostly Very Fine (Not Coarse, Sometimes Greasy or Mucky) — 0 pt

### b) "Smothering"

- [ ] Are Fist Size and Larger Pieces Smothered By Sands/Silts? — NO 5 pt
- [x] Symptoms: Hard to Move Large Pieces, Often Black on Bottom with Few Insects — YES 0 pt

### c) "Silting"

- [ ] Are Silts and Clays Distributed Throughout Stream? — NO 5 pt
- [x] Symptoms: Light Kicking of Bottom Results in Substantial Clouding of Stream for More than a Minute or Two — YES 0 pt

## II. Fish Cover (Hiding Places) - Add 2 Points For Each One Present — Score: 10

- [x] Underwater Tree Roots (Large) — 2 pt
- [ ] Underwater Tree Rootlets (Fine) — 2 pt
- [ ] Boulders — 2 pt
- [ ] Backwaters, Oxbows or Side Channels — 2 pt
- [x] Downed Trees, Logs, Branches — 2 pt
- [x] Shallow, Slow Areas for Small Fish — 2 pt
- [x] Water Plants — 2 pt
- [ ] Deep Areas (Chest Deep) — 2 pt
- [ ] Undercut Banks — 2 pt
- [x] Shrubs, Small Trees that Hang Close Over the Bank — 2 pt

## III. Stream Shape and Human Alterations — Score: 0

### a) "Curviness" or "Sinuousity" of Channel

- [ ] 2 or More Good Bends — 8 pt
- [ ] 1 or 2 Good Bends — 6 pt
- [ ] Mostly Straight Some "Wiggle" — 3 pt
- [x] Very Straight — 0 pt

### b) How Natural Is The Site?

- [ ] Mostly Natural — 12 pt
- [ ] Many Man-made Changes, but still some natural conditions left (e.g., trees, meanders) — 6 pt
- [ ] A Few Minor Man-made Changes (e.g., a bridge, some streambank changes) — 9 pt
- [x] Heavy, Man-made Changes (e.g., leveed or channelized) — 0 pt

## IV. Stream Forests & Wetlands (Riparian Area) & Erosion — Score: 8.5

### a) Width of Riparian Forest & Wetland - Mostly:

- [ ] Wide (Can't Throw A Rock Through/ Across It) — 8 pt
- [x] Narrow (Can Throw A Rock Through/ Across It) — 5 pt
- [ ] None — 0 pt

2.5

### b) Land Use - Mostly:

- [ ] Forest/Wetland — 5 pt
- [ ] Shrubs — 4 pt
- [ ] Overgrown Fields — 3 pt
- [ ] Fenced Pasture — 2 pt
- [ ] Park (Grass) — 2 pt
- [ ] Conservation Tillage — 2 pt
- [ ] Suburban — 1 pt
- [x] Row Crop — 1 pt
- [ ] Open Pasture — 0 pt
- [ ] Urban/ Industrial — 0 pt

### c) Bank Erosion - Typically:

- [x] Stable Hard or Well-Vegetated Banks — 4 pt
- [ ] Combination of Stable and Eroding Banks — 2 pt
- [ ] Raw, Collapsing Banks — 0 pt

### d) How Much of Stream is Shaded?

- [ ] Mostly — 3 pt
- [x] Partly — 2 pt
- [ ] None — 0 pt

1

## V. Depth & Velocity — Score: 1

### a) Deepest Pool is At Least:

- [ ] Chest Deep — 8 pt
- [ ] Knee Deep — 4 pt
- [ ] Waist Deep — 6 pt
- [x] Ankle Deep — 0 pt

### b) Check ALL The Flow Types That You See (Add Points):

- [ ] Very Fast: Hard to Stand in the Current — 2 pt
- [ ] Fast: Quickly Takes Objects Downstream — 3 pt
- [ ] Moderate: Slowly Takes Objects Downstream — 1 pt
- [x] Slow: Flow Nearly Absent — 1 pt
- [ ] None — 0 pt

## VI. Riffles/Runs (Areas Where Current is Fast/Turbulent, Surface May Be Broken) — Score: 0

### a) Riffles/Runs Are:

- [ ] Knee Deep or Deeper & Fast — 8 pt
- [ ] Ankle/Calf Deep & Fast — 6 pt
- [ ] Ankle Deep or Less & Slow — 4 pt
- [x] Do Not Exist — 0 pt

### b) Riffle/Run Substrates Are:

- [ ] Fist Size or Larger — 7 pt
- [ ] Smaller Than Fist Size, but Larger Than Fingernail — 6 pt
- [x] Smaller Than Your Fingernails or Do Not Exist — 0 pt

Date: 4/15

# Citizens Qualitative Habitat Evaluation Index

57 CQHEI Total

Vol ID:

Site ID: 18

River and Watershed: Black Creek @ 530E

## I. Substrate (Bottom Type) — Score: 13

### a) Size

- [ ] Mostly Large (Fist Size or Bigger) — 14 pt
- [x] Mostly Small (Smaller Than Fingernail, but Still Coarse, or Bedrock) — 6 pt
- [x] Mostly Medium (Smaller than Fist, but Bigger than Fingernail) — 10 pt
- [ ] Mostly Very Fine (Not Coarse, Sometimes Greasy or Mucky) — 0 pt

8

### b) "Smothering"

- [x] NO — Are Fist Size and Larger Pieces Smothered By Sands/Silts? — 5 pt
- [x] YES — Symptoms: Hard to Move Large Pieces, Often Black on Bottom with Few Insects — 0 pt

2.5

### c) "Silting"

- [x] NO — Are Silts and Clays Distributed Throughout Stream? — 5 pt
- [x] YES — Symptoms: Light Kicking of Bottom Results in Substantial Clouding of Stream for More than a Minute or Two — 0 pt

2.5

## II. Fish Cover (Hiding Places) - Add 2 Points For Each One Present — Score: 12

- [x] Underwater Tree Roots (Large) — 2 pt
- [ ] Underwater Tree Rootlets (Fine) — 2 pt
- [x] Boulders — 2 pt
- [ ] Backwaters, Oxbows or Side Channels — 2 pt
- [x] Downed Trees, Logs, Branches — 2 pt
- [x] Shallow, Slow Areas for Small Fish — 2 pt
- [ ] Water Plants — 2 pt
- [ ] Deep Areas (Chest Deep) — 2 pt
- [x] Undercut Banks — 2 pt
- [x] Shrubs, Small Trees that Hang Close Over the Bank — 2 pt

## III. Stream Shape and Human Alterations — Score: 13.5

### a) "Curviness" or "Sinuousity" of Channel

- [ ] 2 or More Good Bends — 8 pt
- [x] 1 or 2 Good Bends — 6 pt
- [x] Mostly Straight Some "Wiggle" — 3 pt
- [ ] Very Straight — 0 pt

4.5

### b) How Natural Is The Site?

- [x] Mostly Natural — 12 pt
- [x] Many Man-made Changes, but still some natural conditions left (e.g., trees, meanders) — 6 pt
- [ ] A Few Minor Man-made Changes (e.g., a bridge, some streambank changes) — 9 pt
- [ ] Heavy, Man-made Changes (e.g., leveed or channelized) — 0 pt

9

## IV. Stream Forests & Wetlands (Riparian Area) & Erosion — Score: 9.7

### a) Width of Riparian Forest & Wetland - Mostly:

- [ ] Wide (Can't Throw A Rock Through/ Across It) — 8 pt
- [x] Narrow (Can Throw A Rock Through/ Across It) — 5 pt
- [ ] None — 0 pt

2.5

### b) Land Use - Mostly:

- [x] Forest/Wetland — 5 pt
- [x] Shrubs — 4 pt
- [x] Overgrown Fields — 3 pt
- [x] Fenced Pasture — 2 pt
- [x] Park (Grass) — 2 pt
- [ ] Conservation Tillage — 2 pt
- [ ] Suburban — 1 pt
- [ ] Row Crop — 1 pt
- [ ] Open Pasture — 0 pt
- [ ] Urban/ Industrial — 0 pt

3.2

### c) Bank Erosion - Typically:

- [ ] Stable Hard or Well-Vegetated Banks — 4 pt
- [x] Combination of Stable and Eroding Banks — 2 pt
- [ ] Raw, Collapsing Banks — 0 pt

### d) How Much of Stream is Shaded?

- [ ] Mostly — 3 pt
- [x] Partly — 2 pt
- [ ] None — 0 pt

## V. Depth & Velocity — Score: 5

### a) Deepest Pool is At Least:

- [ ] Chest Deep — 8 pt
- [x] Knee Deep — 4 pt
- [ ] Waist Deep — 6 pt
- [ ] Ankle Deep — 0 pt

### b) Check ALL The Flow Types That You See (Add Points):

- [ ] Very Fast: Hard to Stand in the Current — 2 pt
- [x] Moderate: Slowly Takes Objects Downstream — 1 pt
- [ ] None — 0 pt
- [ ] Fast: Quickly Takes Objects Downstream — 3 pt
- [ ] Slow: Flow Nearly Absent — 1 pt

## VI. Riffles/Runs (Areas Where Current is Fast/Turbulent, Surface May Be Broken) — Score: 4

### a) Riffles/Runs Are:

- [ ] Knee Deep or Deeper & Fast — 8 pt
- [x] Ankle Deep or Less & Slow — 4 pt
- [ ] Ankle/Calf Deep & Fast — 6 pt
- [ ] Do Not Exist — 0 pt

### b) Riffle/Run Substrates Are:

- [ ] Fist Size or Larger — 7 pt
- [x] Smaller Than Your Fingernails or Do Not Exist — 0 pt
- [ ] Smaller Than Fist Size, but Larger Than Fingernail — 6 pt

Date: 4/15

# Citizens Qualitative Habitat Evaluation Index

92.5 CQHEI Total

Vol ID:

Site ID: 19

River and Watershed: Black Creek @ Rt 1

## I. Substrate (Bottom Type) — Score: 17

### a) Size

- [ ] Mostly Large (Fist Size or Bigger) — 14 pt
- [ ] Mostly Small (Smaller Than Fingernail, but Still Coarse, or Bedrock) — 6 pt
- [x] Mostly Medium (Smaller than Fist, but Bigger than Fingernail) — 10 pt
- [ ] Mostly Very Fine (Not Coarse, Sometimes Greasy or Mucky) — 0 pt

12

### b) "Smothering"

- [x] NO — Are Fist Size and Larger Pieces Smothered By Sands/Silts? — 5 pt
- [ ] YES — Symptoms: Hard to Move Large Pieces, Often Black on Bottom with Few Insects — 0 pt

2.5

### c) "Silting"

- [x] NO — Are Silts and Clays Distributed Throughout Stream? — 5 pt
- [ ] YES — Symptoms: Light Kicking of Bottom Results in Substantial Clouding of Stream for More than a Minute or Two — 0 pt

2.5

## II. Fish Cover (Hiding Places) - Add 2 Points For Each One Present — Score: 16

- [x] Underwater Tree Roots (Large) — 2 pt
- [x] Boulders — 2 pt
- [x] Downed Trees, Logs, Branches — 2 pt
- [ ] Water Plants — 2 pt
- [x] Undercut Banks — 2 pt
- [x] Underwater Tree Rootlets (Fine) — 2 pt
- [x] Backwaters, Oxbows or Side Channels — 2 pt
- [x] Shallow, Slow Areas for Small Fish — 2 pt
- [ ] Deep Areas (Chest Deep) — 2 pt
- [ ] Shrubs, Small Trees that Hang Close Over the Bank — 2 pt

## III. Stream Shape and Human Alterations — Score: 20

### a) "Curviness" or "Sinuousity" of Channel

- [x] 2 or More Good Bends — 8 pt
- [ ] 1 or 2 Good Bends — 6 pt
- [ ] Mostly Straight Some "Wiggle" — 3 pt
- [ ] Very Straight — 0 pt

### b) How Natural Is The Site?

- [x] Mostly Natural — 12 pt
- [ ] Many Man-made Changes, but still some natural conditions left (e.g., trees, meanders) — 6 pt
- [ ] A Few Minor Man-made Changes (e.g., a bridge, some streambank changes) — 9 pt
- [ ] Heavy, Man-made Changes (e.g., leveed or channelized) — 0 pt

## IV. Stream Forests & Wetlands (Riparian Area) & Erosion — Score: 20

### a) Width of Riparian Forest & Wetland - Mostly:

- [x] Wide (Can't Throw A Rock Through/ Across It) — 8 pt
- [ ] Narrow (Can Throw A Rock Through/ Across It) — 5 pt
- [ ] None — 0 pt

### b) Land Use - Mostly:

- [x] Forest/Wetland — 5 pt
- [ ] Shrubs — 4 pt
- [ ] Overgrown Fields — 3 pt
- [ ] Fenced Pasture — 2 pt
- [ ] Park (Grass) — 2 pt
- [ ] Conservation Tillage — 2 pt
- [ ] Suburban — 1 pt
- [ ] Row Crop — 1 pt
- [ ] Open Pasture — 0 pt
- [ ] Urban/ Industrial — 0 pt

### c) Bank Erosion - Typically:

- [x] Stable Hard or Well-Vegetated Banks — 4 pt
- [ ] Combination of Stable and Eroding Banks — 2 pt
- [ ] Raw, Collapsing Banks — 0 pt

### d) How Much of Stream is Shaded?

- [x] Mostly — 3 pt
- [ ] Partly — 2 pt
- [ ] None — 0 pt

## V. Depth & Velocity — Score: 7

### a) Deepest Pool is At Least:

- [ ] Chest Deep — 8 pt
- [x] Knee Deep — 4 pt
- [ ] Waist Deep — 6 pt
- [ ] Ankle Deep — 0 pt

### b) Check ALL The Flow Types That You See (Add Points):

- [ ] Very Fast: Hard to Stand in the Current — 2 pt
- [ ] Moderate: Slowly Takes Objects Downstream — 1 pt
- [ ] None — 0 pt
- [x] Fast: Quickly Takes Objects Downstream — 3 pt
- [ ] Slow: Flow Nearly Absent — 1 pt

## VI. Riffles/Runs (Areas Where Current is Fast/Turbulent, Surface May Be Broken) — Score: 12.5

### a) Riffles/Runs Are:

- [ ] Knee Deep or Deeper & Fast — 8 pt
- [ ] Ankle Deep or Less & Slow — 4 pt
- [x] Ankle/Calf Deep & Fast — 6 pt
- [ ] Do Not Exist — 0 pt

### b) Riffle/Run Substrates Are:

- [x] Fist Size or Larger — 7 pt
- [ ] Smaller Than Your Fingernails or Do Not Exist — 0 pt
- [x] Smaller Than Fist Size, but Larger Than Fingernail — 6 pt

6.5


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